THE SCOTTISH
FUEL POVERTY
ADVISORY PANEL

The unintended consequences of decarbonisation technologies for fuel poverty outcomes: a systematic review of issues and mitigations

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Key findings

- Fuel poverty rates are on the rise, with rising household energy costs exacerbating the cost of living in the UK. This disproportionately affects vulnerable households, potentially worsening their health and overall quality of life.[1]
- Groups with intersecting demographics at risk of fuel poverty should be given greater focus, for example minority ethnic households, students, low-income renters, disabled people living in rural and off-grid housing.
- Four key technologies were identified as key to domestic decarbonisation: heat pumps, hydrogen, heat networks and insulation.
- Of the key technologies identified, little mention was made of what unintended consequences these technologies could have for fuel poverty. Except for heat pumps, the technologies were all presented in terms of benefits and opportunities.
- The primary unintended consequence of note is the unaffordability of decarbonisation technologies for at risk groups, who are likely to already be low-income.
- Home decarbonisation technologies come with the opportunity to decrease fuel poverty while contributing to net zero if implemented effectively with supportive government schemes.
- Several existing schemes and grants are inaccessible to the fuel poor living in Scotland due to closure or limited availability outside England. The Scottish Government should assess the effectiveness of these initiatives to determine if similar measures should be adopted in Scotland.

1. Introduction

For Scotland and the wider UK to be on course to achieve their net zero goals, households will not only need to use decarbonisation technologies, but will need to increase the speed and rate at which these technologies are adopted.[2] The potential for the net zero transition to benefit the Scottish people is high, but the transition may also bring unintended consequences for people already at risk of fuel poverty. People who are currently suffering from or at risk of fuel poverty (hereafter referred to as "at risk") are also at risk of being left behind during the net zero transition.

The research that supports this conclusion involved a process of systematic literature review and literary thematic analysis. This also allowed for the identification of gaps in the existing research. The first step of the research process was defining the scope, which involved setting a date range as well as selecting the types of

[1] Dellaccio, O., Dicks, J., et al. (2022). *The distributional effects of pathways to net-zero and the implications for fuel and transport poverty*.
[2] Department for Energy Security and Net Zero & Department for Business, Energy & Industrial Strategy. (2020). Energy white paper: Powering our net zero future.

documents that would be most relevant (e.g. original research articles). The following step involved identifying inclusion and exclusion criteria as well as key phrases. Appendix A gives the full list of inclusion and exclusion criteria for documents used in the analysis as well as key phrases used to search on the databases.[3] Key phrases were used to search for potentially relevant documents within the defined search criteria and scope. This resulted in hundreds of potentially relevant documents. The next step was to skim the titles abstract, conclusion and key points for literature that fit within the criteria for relevance. The 23 final documents that were deemed relevant were read once before a second, in–depth read to identify themes within the documents, generating qualitative data for this study. The themes identified can also be seen in Appendix A, with the most relevant themes being explored in more depth below.

2. Themes Identified

2.1 Marginalised Groups

Marginalised groups and groups most likely to be at risk of fuel poverty appeared as a consistent theme. Identified groups included disabled people, people suffering from illness, single parents, parents of young children, older people, renters, people living off-grid, people in social housing, low-income households, rural households, minority ethnic households[4] and disabled older people. Highlighted groups of concern included renters, who face multiple factors which increase their vulnerability to fuel poverty, such as barriers accessing government schemes due to their limited control over heating systems and often low standards of property energy efficiency.[5] According to the Scottish House Condition Survey 2022, renters in both the social and private housing sectors have higher rates of fuel poverty, with 48% of households renting from a local authority, 47% of households renting from a housing association and 44% of private rented sector households being fuel poor.[6]

2.2 Technologies

The relevant technologies discussed in the literature included heat pumps, smart meters, insulation, low-carbon boilers, nuclear, electric vehicles, solar, biomass boilers, advanced storage heaters, heat networks, hydrogen boilers, hydrogen, electric heating, solar panels, wind, wind turbines, LED light bulbs, thermal retrofitting, electric heat pumps, air-source heat pumps, ground-source heat pumps, energy retrofitting, and battery storage. According to the number of times they were mentioned in the literature, four “key technologies” were identified as key to domestic

[3] The databases used were Google with advanced search functions, and ScienceDirect.
[4] Includes non-white demographics and minority white demographics (Gypsy/Travellers, non-British white groups).
[5] National Energy Action. (2023). *Written evidence submitted by National Energy Action* (HEA0158). UK Parliament.
[6] Scottish Government. (2024). *Scottish House Condition Survey: 2022 Key Findings*.

decarbonisation: heat pumps, hydrogen, heat networks, and insulation.[7] Heat pumps were directly mentioned regarding the risks this technology could pose to low-income groups when installed in poorly insulated homes,[8] but the other key technologies were primarily associated with benefits and opportunities with little to no regard of unintended or actual negative consequences.

2.3 Unintended Consequences

The main unintended consequence identified in the reviewed literature was the unaffordability of decarbonisation technologies for groups of people who are likely to already be struggling financially, including the fuel poor. This occurred both at the stage of installation, and in terms of running costs. This is summarised in the following excerpt from National Energy Action's evidence submitted to the Energy Security and Net Zero Committee of the UK Parliament:

> "Fuel poor households face significant barriers to upgrading their homes, most notably financial barriers to cover upfront costs, and the potential of higher running costs if new heating technologies are installed…If barriers are not removed, there is a significant risk that the net zero transition becomes unfair, and unaffordable for the most vulnerable people in society."[9]

A further unintended consequence of decarbonisation technologies that was noteworthy was the need for change in people's behaviours. Specifically, there was discussion around how using hydrogen to heat and cook in the home may change behaviours.[10] In addition, heat pumps will not heat homes in the same way as traditional oil and gas boilers, requiring both behaviour change and education.[11]

3. Opportunities for Mitigation

Opportunities for these technologies were identified in a report published by the House of Commons' Business, Energy and Industrial Strategy Committee which focused on decarbonising heat in homes. In particular the report highlighted that decarbonisation technologies, such as heat pumps and hydrogen, can facilitate the transition to net zero by decarbonising heat in homes.[12] As emphasised by the

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[7] While not explicitly a technology, insulation is a key aspect of retrofitting homes for decarbonisation.

[8] Abbasi, M. H., Abdullah, B., et al. (2022). Planning energy interventions in buildings and tackling fuel poverty: Can two birds be fed with one scone? *Energy Research & Social Science*, 93, 102841. https://doi.org/10.1016/j.erss.2022.102841

[9] National Energy Action. (2023). *Written evidence submitted by National Energy Action (HEA0158)*. UK Parliament.

[10] Scott, M., & Powells, G. (2020). Towards a new social science research agenda for hydrogen transitions: Social practices, energy justice, and place attachment. *Energy Research & Social Science*, 61, 101346. https://doi.org/10.1016/j.erss.2019.101346

[11] Business, Energy and Industrial Strategy Committee. (2022). *Decarbonising heat in homes*. House of Commons.

[12] Business, Energy and Industrial Strategy Committee. (2022). *Decarbonising heat in homes.* House of Commons.

Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy in their Energy White Paper, these technologies can also play a vital, wider role in decarbonisation, leading to job creation and improving energy efficiency in buildings with further opportunities to contribute to environmental sustainability.[13]

Mitigation opportunities to protect against unintended negative consequences for vulnerable groups as well as recommendations were also explored, and a variety of government policy and schemes were identified. While some of the grey literature reviewed came from the Scottish Government and was therefore applicable to residents in Scotland, much of the literature reviewed from the UK Government related primarily to residents of England. This, in part, explains why many of the identified schemes and grants (a full list of which is given in Appendix B) are only available to residents of England. However, recommendations and key points have been identified to improve the success rate of these and similar schemes if they were to be adopted in Scotland.

The schemes that were most relevant to this research would involve funding that allows for at risk groups to invest in decarbonisation technologies and mitigate the negative consequences of using these. Specific to heat pumps, with government support to help cover the high upfront costs, there is an opportunity for this technology to reduce fuel poverty.[14] This understanding could be applied to other relevant technologies.

4. Recommendations

As highlighted by Climate Citizens and Lancaster University (2022), the Department for Energy Security and Net Zero and Department for Business, Energy & Industrial Strategy, (2020) and the National Grid, (2023), key recommendations include:

- Awareness gap: while concern about climate change is high, homeowners' awareness of the necessary changes for home energy decarbonisation is low, and the government should therefore raise awareness among homeowners about its importance, including for those vulnerable to fuel poverty.
- Communication strategy: messaging should emphasise the benefits of energy retrofitting, such as increased comfort and cost savings, alongside climate benefits because climate change alone may not be a strong motivator for change.
- Financial support: even households not in fuel poverty may require financial support. This support could come in the form of low-interest loans and grants which target inefficient homes to facilitate action on home decarbonisation.

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[13] Department for Energy Security and Net Zero & Department for Business, Energy & Industrial Strategy. (2020*). Energy white paper: Powering our net zero future.*

[14] Zhou, Y., Essayeh, C., Darby, S., & Morstyn, T. (2024). Evaluating the social benefits and network costs of heat pumps as an energy crisis intervention. *iScience*, 27(2), 108854. https://doi.org/10.1016/j.isci.2024.108854

- Minimise disruption: when transitioning to clean heat, prioritise points of least disruption to consumers, such as the replacement cycle for existing heating systems or when existing equipment needs upgrading. Ensure consumers receive fair value and access to advice and information during these transitions, working with the market to reduce costs and address barriers to deploying new technologies.
- Build trust: the public are often aware of the failures and successes of previous initiatives, and consumer trust is integral to any new schemes or improvements made on existing schemes. Long-term support must be ensured for people willing to invest in home decarbonisation.
- Community engagement: the Scottish Government should incorporate community engagement into the decarbonisation and decision-making processes. As indicated by the researchers Carley and Konisky[15] from Indiana University, involving the public can provide valuable local insights, inform policy development, and foster a more positive perception of decision outcomes. Therefore, it is essential for new schemes or policies to prioritise involvement from affected communities to the greatest extent possible.

5. Research Gaps

The most substantial gap in the literature is around the scant attention paid to the potential negative consequences of household decarbonisation technologies, with only heat pump literature revealing any potential risks for the fuel poor and the risks identified appearing largely terms of economic impacts and behavioural change. Further gaps in the research are mainly related to either groups not identified as being at risk, or the different intersections affecting at risk groups, groups that would be classified as suffering from “double-energy vulnerability” by Simcock et al.[16] Groups of note include:

- Students: as students are potentially at an intersection of various of the at risk groups; low-income, renters, and potentially of minority ethnicity.
- Large families in large houses who have high housing and living costs. To capture these groups fuel poverty could be measured per capita rather than per household.
- Low-income individual living in the worst-quality and least-efficient homes: there is a clear connection between low-income households and those living in the worst quality housing stock.

Further research looking into the potential effects of smart meters on at risk groups is also recommended. Smart meters were not included as a key technology in this report but the potential impacts on the fuel poor are high. Sovalcool et al. from the

[15] Carley, S., & Konisky, D. M. (2020). The justice and equity implications of the clean energy transition. *Nature Energy*, 5(4). https://doi.org/10.1038/s41560-020-0641-6

[16] Simcock, N., Jenkins, K., et al. (2021). Identifying double energy vulnerability: A systematic and narrative review of groups at risk of energy and transport poverty in the global north. Energy Research & Social Science, 82, 102351. https://doi.org/10.1016/j.erss.2021.10235

University of Sussex have written about perceived 'injustices' regarding smart meters[17], and Citizens Advice have highlighted the need for government to ensure data protections are in place for users of smart meters.[18]

6. Conclusion

It is evident that groups already vulnerable to fuel poverty face the risk of being left behind in the process of decarbonisation. The primary concerns and unintended consequences of key decarbonisation technologies include high upfront costs and economic competitiveness compared to fossil fuel-based technologies. It is imperative for new and improved support schemes to prioritise low-income communities and groups at risk of double energy vulnerability, given their heightened vulnerability to fuel poverty. While affordability remains a significant challenge, bridging the information gap between existing schemes and public awareness of these initiatives is equally critical. While consumer protections are acknowledged, specific safeguards for the fuel poor are often overlooked. Building efficiency and insulation are increasingly recognised as crucial factors in identifying and mitigating fuel poverty, highlighting the need for comprehensive indicators of at risk groups.[19] [20] By addressing these concerns and implementing targeted strategies, policymakers can mitigate the risks of fuel poverty exacerbation and ensure an inclusive and equitable transition to net zero.

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[17] Sovacool, B. K., Hook, A., et al. (2019). The whole systems energy injustice of four European low-carbon transitions. *Global Environmental Change*, 58, 101958. https://doi.org/10.1016/j.gloenvcha.2019.101958

[18] Citizens Advice. (2020). *Zero sum: How to prioritize consumer protections to ensure nobody is left behind on the path to net zero.*

[19] Abbasi, M. H., Abdullah, B., et al. (2022). Planning energy interventions in buildings and tackling fuel poverty: Can two birds be fed with one scone? *Energy Research & Social Science*, 93, 102841. https://doi.org/10.1016/j.erss.2022.102841

[20] Best, R., & Sinha, K. (2021). Fuel poverty policy: Go big or go home insulation. *Energy Economics*, 97, 105195. https://doi.org/10.1016/j.eneco.2021.105195

Appendix A - Methodology

A.1 Inclusion and Exclusion Criteria

- Date range: 1st January 2019 - February 28th 2024. The date cutoff was to ensure the relevance and timeliness of the data.
- Exclusion criteria: English only; no books; no book reviews; no newspapers or social media; no industrial/commercial. This was to ensure the data could be understood easily and to limit the sources of literature to the most reputable sources.
- Inclusion criteria: original research articles; perspective articles; review articles; government; government/parliament research organisations; NGOs/charities etc.; domestic scope. Again, this was to ensure the legitimacy and quality of the information being sourced.

Using these criteria initial documents were sourced and then went through a more in-depth process of reading the abstract and conclusion if relevant, or the forward and key points. This was done to decide if the document was worth retaining in the sample and coding in full. During this process, the documents were skim read to see if they discussed the following:

- key decarbonisation technologies
- groups at risk of fuel poverty or suffering from fuel poverty
- recommendations or mitigations

A.2 Search Terms, Keywords and Phrases

The terms and phrases included in the keyword search were fuel poverty plus the following:

- hydrogen
- renewable energy sources
- wind
- solar energy
- decarbonisation
- social impact assessment
- decarbonisation technology
- economic impact assessment
- unintended consequences
- risk

A.3 Themes

Themes identified included:

- socioeconomic status/demographic groups/marginalised groups of concern
- policy recommendations/policy
- unintended consequences/impacts
- opportunities/benefits
- timescale

- technologies
- mitigations/solutions
- location – urban/rural

Appendix B - Available Grants and Schemes

A number of grants and schemes were identified in the literature review,[21] these included:

Lowering bills

- Warmer Homes Scotland: offers funding and support to households struggling to stay warm and keep on top of energy bills, for residents in Scotland.
- Warm home discount: a one-off £150 discount off an electricity bill which is available to those on a low-income in Scotland.

Funding for decarbonisation technologies

- Home Energy Scotland Grant and Loan: grants and/or an interest-free loan for efficiency measures funded by the Scottish Government, applicable to residents of Scotland.
- Great British Insulation Scheme: a government energy efficiency scheme that is administered by Ofgem. It is designed to deliver improvements to the least energy-efficient homes in Great Britain to help tackle fuel poverty and reduce carbon emissions. Open to residents of England, Scotland and Wales who meet the eligibility criteria.
- Private Rented Sector Landlord Loan: funded loan that helps landlords improve the energy efficiency of their properties and meet minimum standards, available to private landlords in Scotland that meet the eligibility criteria.

Incentive to install renewable energy

- Smart Export Guarantee (SEG): a support mechanism that ensures people that generate their own electricity are paid for the electricity they export to the grid. Open to people in England, Scotland, and Wales who need to apply directly to a SEG tariff supplier to start getting payments.

Certain schemes are grants have closed and /or operate out with Scotland, including:

- Feed-in-Tariff Scheme
- Green Homes Grant Scheme
- Renewable Heat Incentive
- Social Housing Decarbonisation Fund (and only for England)
- Green Heat Network Fund
- Social Housing Decarbonisation Fund
- Boiler Upgrade Scheme (England and Wales)
- Home Upgrade Grant
- Energy Bills Rebate

[21] Secretary of State for Business, Energy and Industrial Strategy. (2021). *Heat and Buildings Strategy*. HM Government.

- Energy Savings Opportunity Scheme

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