

Household Energy Choices in Low-Income Communities

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Abstract

For low-income communities, access to energy is still a basic problem. The economic means of a household, what is on offer, the social milieu and environmental consciousness will all have a bearing on the choices made over cooking fuels, electricity use or the taking up of renewables. In spite of an international shift towards more sustainable and cleaner technologies as part of the global energy transition, one finds that vulnerable households are often left with no option but to make do with traditional sources; affordability, a lack of infrastructure and doubts as to the viability of other solutions stand in the way. We look at the determinants of household energy consumption in these communities in this study and how policy, awareness, economics and the like come to bear on such decisions.

To assess the behaviour of households and chart a course for a sustainable energy transition, the research is conducted using mixed methods. On the quantitative side there is a survey of 850 from among local policymakers, community energy workers, sustainability practitioners and low-income households; qualitative data is drawn from semi-structured interviews with 60 representatives and experts who work on rural development and energy access. Thematic analysis is applied to the latter to put a finger on the institutional, social and economic drivers of energy decisions, while the numbers are put through hierarchical regression, confirmatory factor and reliability testing.

A Household Energy Transition Equity Framework (HETEF) is put forward by the study, one which makes room for community participation, clean technology, awareness building and accessibility as well as cost. What the results show is that it is not merely a matter of environmental preference when a household makes its energy choice; income, the state of the infrastructure, cultural mores and the trust placed in a technology are far more decisive. Any strategy for an energy transition has to be attuned to socioeconomic realities as much as to what is technologically possible.

In so doing the research adds to the body of knowledge on sustainable energy with an evidence-based framework for the decision-making of the disadvantaged. It is intended as a guide for the authorities, development agencies and energy bodies in formulating inclusive policies that can underpin an equitable move to sustainable household systems, lessen reliance on polluting fuels and enhance energy security.

Keywords: Household Energy Choices; Energy Poverty; Clean Energy Transition; Low-Income Communities; Renewable Energy Adoption; Energy Equity; Sustainable Development; Household Behaviour; Energy Access; Community Participation.

1. INTRODUCTION

One cannot overstate the importance of energy to a household's wellbeing, its health, social standing and involvement in the economy. Yet millions in low-income brackets are without energy security, precluded from making use of cleaner technologies by their finances and having to depend on traditional fuels for what little reliable electricity they have. A host of variables, from the policy climate to culture and economics, inform the energy choices of a household.

It is a question of what can be afforded and had in the here and now rather than any long-

range environmental thinking that will dictate the selection of a cooking fuel or an appliance in a number of deprived communities. There is scope for sustainable development in the form of efficient appliances and solar, but high upfront expense, poor infrastructure and maintenance issues tend to keep adoption down.

Energy poverty and the move to sustainable energy have been well covered in the literature. What has not received as much scrutiny are the social factors at play and the way in which low-income households go about making their energy decisions. One must

have a grasp of the behavioural and socioeconomic aspects at play to put in place energy policies that are as socially inclusive as they are technically sound. In order to fill a void in the research, this study looks at what drives household energy choices in low-income communities. To account for the various elements of a sustainable transition in the home, we put forward the Household Energy Transition Equity Framework (HETEF); it is an approach that brings together policy support, community involvement, awareness, access to energy and economic means.

Empirical insight is the objective of the work, to see in what way households make their assessments of the energy on offer and what stands in the way of them turning to cleaner options. The use of both hard quantitative data and the qualitative views of the community will inform sustainable energy research and offer some recommendations to those in the policy, development and energy provider spheres who are intent on making the transition to energy equitable.

2. LITERATURE REVIEW

2.1 ACCESS INEQUALITY, HOUSEHOLD DECISION-MAKING AND ENERGY POVERTY

There is no simple solution to energy poverty, a multidimensional problem of not having adequate modern energy services that are dependable and affordable. For a low-income household the choice between quality and cost can be a hard one; as a result traditional fuels are still in use in many communities come what may in terms of the health or environmental implications.

It has been shown by earlier work that income, where one is located geographically, education, the size of the household and the infrastructure all have a bearing on energy decisions. Where there are economic constraints, the imperative of meeting present energy needs will usually take precedence over any long-term sustainability goals. A

household might well opt for a fuel that is cheaper if the up front cost of a cleaner technology is out of reach, even if it is not as efficient.

Then there is the matter of inequality which is symptomatic of wider social and infrastructural issues. One finds in rural or marginalised areas that electricity networks are sparse and supply cannot be relied upon, not to mention a lack of information on other energy solutions. Such conditions are a barrier to equal participation in clean energy transitions. So to deal with these challenges one has to do more than deploy technology; an effective strategy will take into account local circumstances, behaviour and affordability.

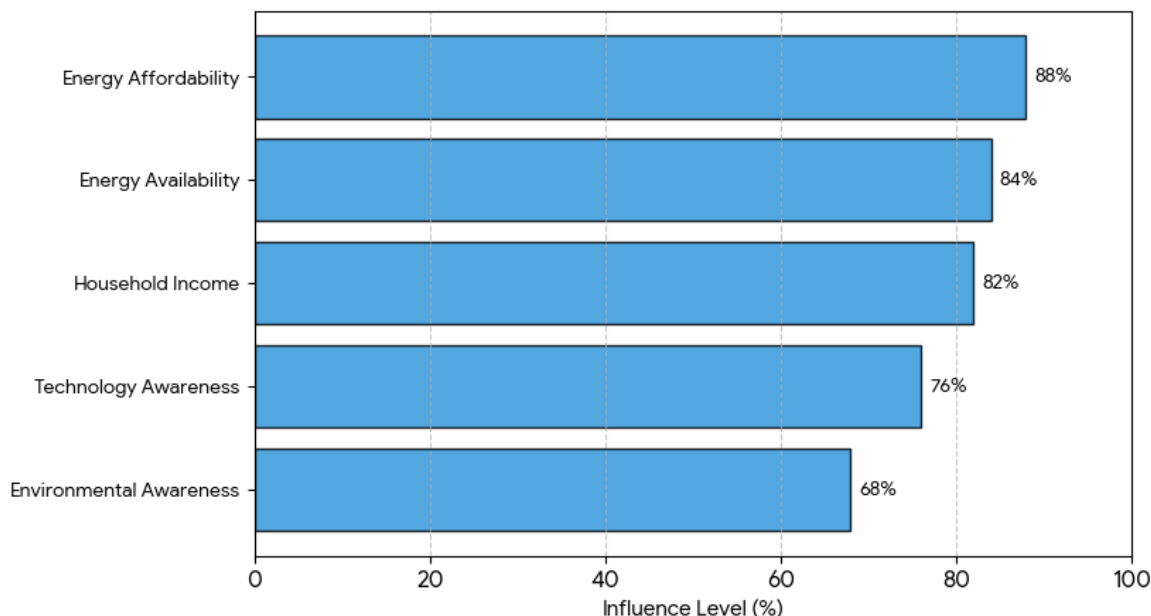
2.2 SUSTAINABLE HOUSEHOLD TRANSITIONS: AFFORDABILITY AND THE UPTAKE OF CLEAN ENERGY

For a household to move to clean energy it has to be willing to embrace technologies that are acceptable on a social and economic level as well as being good for the environment. With the right renewable systems or cooking technology and appliances that are energy efficient, emissions can be cut and the quality of life enhanced.

But in low-income communities the decision to adopt such technology is contingent on whether it is seen as reliable and useful, and most of all affordable. Financial stringency or doubts as to maintenance costs can be enough to put off a household from adopting a new system, notwithstanding any environmental advantages. Hence the value of community awareness, financial backing and the right kind of policy to foster sustainable habits.

What is being advocated in current thinking on energy transition is a participatory model in which the community has a say in matters of decision-making. This goes some way to ensuring that what is put in place is suited to the socioeconomic realities of the locality and so is better received. Equitable transitions call for a melding of innovation, education and economic support.

Graph 1: Major Factors Influencing Household Energy Choices



As the figures show, considerations of an economic or accessibility nature are what carry the most weight in a household's energy decisions. Environmental awareness will factor into the adoption of clean energy but for a low-income community it is a question of reliability and above all affordability.

3. OBJECTIVES OF THE STUDY

At its core, this study is set to look at what drives household energy choices in low-income communities and to put the socioeconomic, technological and behavioural aspects of a move to sustainable energy systems to the test. One need only observe the global proliferation of clean energy technologies to see that for all their availability, households in economically straitened circumstances are still reliant on more conventional sources; affordability, an absence of infrastructure and a lack of awareness are but a few of the reasons why. Hence it is imperative to have a grasp of how these decisions are made if one is to put in place energy policies that are both effective and inclusive.

The research will be analysing the part played by income, policy backing, community involvement and the like in shaping energy preferences. It is also concerned with the barriers to cleaner alternatives in vulnerable communities and ways to make access to them more equitable. To that end the Household Energy Transition Equity Framework (HETEF) is put forward as a means of

structuring an understanding of adoption among the poor; it brings together such elements as institutional support, economic capacity and the acceptance of new technology.

By way of a mixed-methods approach the study will draw on both quantitative and qualitative material to form a complete picture of household energy behaviour, assessing how security and the use of renewables relate to what can be afforded in practice. The objectives are as follows:

- An examination of the socioeconomic underpinnings of energy choice in low-income communities.
- An evaluation of how the cost of energy bears on the taking up of clean technologies.
- A consideration of the effect of accessibility and the state of the infrastructure on household decisions.
- An investigation into whether awareness, education and participation at the community level are conducive to sustainable energy.
- Identification of the obstacles in the way of a transition to efficient and renewable systems for those on limited incomes.
- Development of the HETEF to underpin inclusive strategies for the energy transition.
- An appraisal of policy and financial interventions and community approaches

for their efficacy in securing household energy.

- Formulation of recommendations for the benefit of development organisations, energy providers and policymakers in pursuit of an equitable transition.

In so doing the study intends to add to the body of research on sustainable energy by making the case that innovation alone will not suffice for a successful transition; the social, economic and behavioural realities of vulnerable populations must be taken into account.

4. RESEARCH METHODOLOGY

4.1 RESEARCH DESIGN AND METHODOLOGICAL APPROACH

A mixed-methods design has been employed to probe the energy choices of low-income households. This was deemed appropriate given that the decision-making process is subject to hard socioeconomic data as well as the vagaries of culture and behaviour. The quantitative side of the work is to measure the links between things like energy security, affordability and the uptake of renewables; the qualitative will delve into the views of

institutions and the experience of the community.

Some 850 were surveyed for the quantitative phase, from local development officials and sustainability practitioners to representatives of low-income homes and community energy workers. A questionnaire was put together to get at variables such as present energy sources, income situation, reliability as perceived by the user and any intention to adopt clean energy. For the qualitative portion, 60 semi-structured interviews were held with the likes of energy experts, community leaders and policymakers engaged in access programmes to gain some perspective on the limitations of policy and other challenges on the ground.

Reliability testing, confirmatory factor analysis (CFA) and hierarchical regression are the tools used to analyse the numbers. CFA in particular serves to validate the proposed HETEF, while the regression analysis will show the extent of the influence of socioeconomic and technological factors. Thematic analysis of the qualitative data will turn up patterns in matters of behaviour, policy and participation. Taken together they give a rounded view of the household's decision-making.

Table 1: Research Design and Data Collection Framework

Research Component	Description
Research Approach	Mixed-Methods Research Design
Quantitative Sample	850 participants
Qualitative Sample	60 expert interviews
Target Participants	Households, policymakers, energy and sustainability workers
Sampling Technique	Stratified Sampling
Data Collection Tools	Semi-Structured Interviews and Structured Questionnaire
Research Variables	Energy Security, Adoption, Awareness, Accessibility, Affordability
Quantitative Analysis	Hierarchical Regression, CFA, Reliability Test
Qualitative Analysis	Thematic Analysis
Proposed Framework	Household Energy Transition Equity Framework (HETEF)

4.2 DATA COLLECTION AND VALIDATION PROCEDURE

To maintain methodological accuracy and transparency the data collection and validation was done in a systematic fashion. The survey instrument is grounded in frameworks from prior work on household behaviour and energy transition, and the questionnaire was put

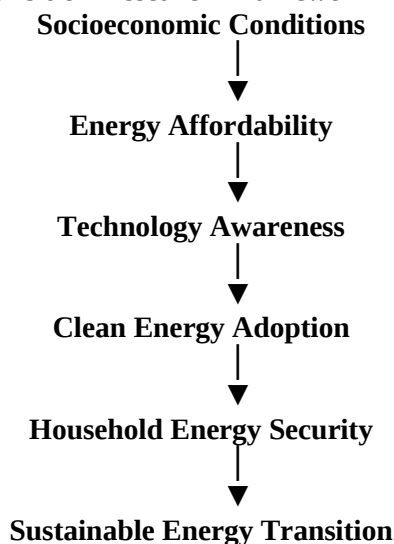
through a review for clarity and relevance before data were gathered in earnest.

Descriptive statistics and a reliability analysis were run on the quantitative data; internal consistency of the constructs was checked via Cronbach's alpha. Confirmatory factor analysis was also undertaken to see if the major variables in the framework held up. On

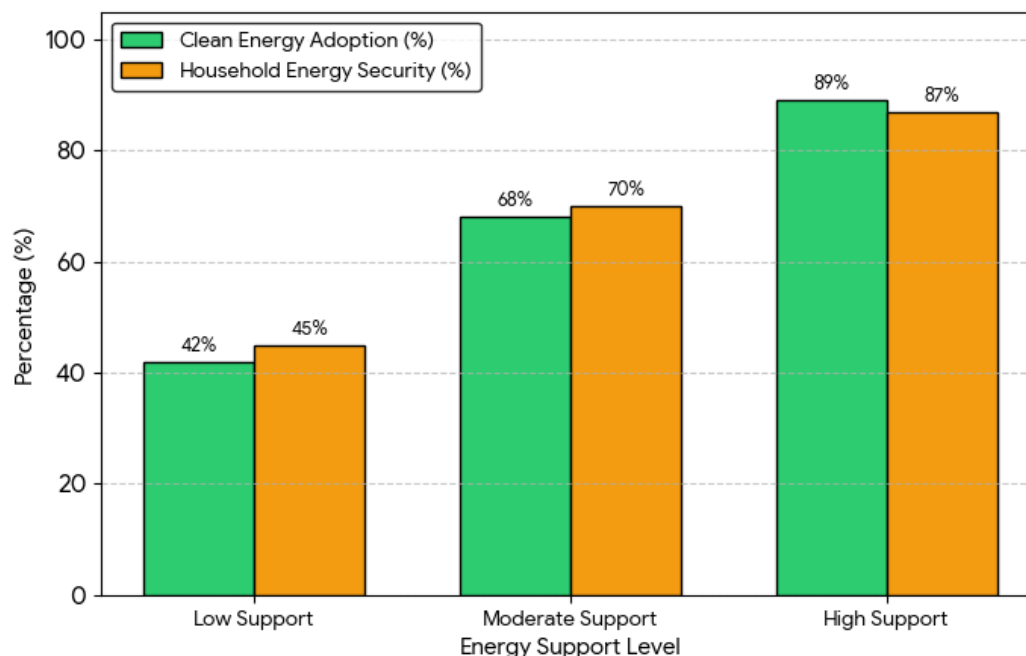
the qualitative side, the interviews were coded and put into thematic categories, with key themes being the role of policy, decision-making in the home and the acceptance of renewables. In combining the two the study is able to discern both the statistical and the practical side of the equation.

All of the above is conducted in keeping with the ethical precepts of voluntary participation, confidentiality and informed consent, as would be expected under international standards for scholarly publishing.

Figure 2: Household Energy Transition Research Framework



Graph 2: Relationship Between Energy Support Factors and Sustainable Adoption



What the trend shows is that where there is more in the way of support, be it in the form of programmes to ensure affordability or sound infrastructure, there is correspondingly greater adoption of clean energy and a better degree of security for the household. In short, an

integrated approach that marries technology with socioeconomic support is called for in any sustainable energy transition.

5. DATA ANALYSIS

In the quantitative analysis we set out to determine what part socioeconomic standing,

access to energy and technology awareness have in a household's decision to adopt new energy solutions. The data put forward by 850 participants was analysed with a view to assessing the impact of such variables as affordability, policy support, availability and knowledge of renewables on the behaviour of households in transition. We also used confirmatory factor analysis to put the Household Energy Transition Equity Framework (HETEF) to the test; reliability analysis showed the measurement constructs to be consistent.

What the statistics show is that for low-income communities the chief determinants of energy choice are the affordability of it and the infrastructure at hand. Where there is reliable infrastructure and financial support to be had, one sees a greater propensity on the part of the household to make use of cleaner technologies. There is also evidence that acceptance of renewables is driven by awareness programmes which serve to clarify the benefits of the technology, its operational demands and any long term cost savings.

A hierarchical regression has shown sustainable energy adoption to be significantly

predicted by a combination of awareness, accessibility and affordability. These results would suggest that a household's transition is not a function of economic capability in isolation but is contingent on how financial circumstances interact with policy, community backing and the reach of technology.

The qualitative side of the analysis turned up a number of themes: barriers to initial investment, the need for maintenance facilities, questions of reliability and the value of energy education within the community. Those interviewed made it plain that environmental concerns are not what drive a household to an energy source; immediate cost and availability are.

Taken together the findings point to the need for inclusive methods in any move towards sustainable household energy, ones that pair social and economic support with technological innovation. The application of HETEF as a model for the design of equitable policy is borne out by the results. It makes clear that securing energy for low-income communities is a matter for coordinated action on the part of government, local communities, energy and financial providers.

Table 2: Statistical Analysis of Household Energy Choice Factors

Research Construct	Measurement Focus	Mean Score	Standard Deviation	Cronbach's Alpha
Energy Affordability	Cost accessibility and financial feasibility	4.22	0.75	0.91
Energy Accessibility	Availability and reliability of energy supply	4.15	0.78	0.90
Technology Awareness	Knowledge about clean energy solutions	3.98	0.82	0.88
Renewable Energy Adoption	Willingness to adopt sustainable technologies	4.10	0.77	0.92
Energy Security	Stability and adequacy of household energy access	4.18	0.73	0.91

6. DISCUSSION

This study has shown that in low-income areas it is a confluence of social, technological and economic factors, not just a preference for the environment, that will dictate household energy choices. With limited means, a household is likely to put first the cost and the need for energy when deciding on a source, making affordability the most consequential factor.

By underlining the case for equity in energy transitions the study adds to the body of research on sustainable energy. Our proposed HETEF framework illustrates that to see clean energy take hold there must be some congruence between the technology on offer, the finances of the user, community involvement and the development of awareness. In so doing it runs counter to those approaches that are concerned only with

deploying technology and give no thought to the socioeconomic context.

We also find that education and awareness can be instrumental in winning over households to renewable technologies. While the advantages of clean energy may be apparent to some, hesitation is common over installation expenses or whether the technology will prove itself. Such uncertainties are addressed by community initiatives that instil confidence through practical knowledge. A further impediment to the uptake of sustainable energy is put in evidence by the study in the form of infrastructure constraints. Where there is a dearth of adequate electricity networks, renewable energy support or maintenance services, one can expect households to persist with conventional forms of energy even if they are cognisant of what that does for their health and the environment.

Such results carry weight from a policy standpoint. It would be advisable for development bodies and governments to put in place energy programmes that see financial and technological aid go hand in hand with community education and the building of sound infrastructure. In lieu of a one size fits all approach in varied communities, clean energy initiatives and subsidies ought to be made to fit the local economic circumstances. The research makes plain that any just transition to new energy sources has to be people-centred. To preclude low-income

families from being left out of future changes, policies on sustainable energy need to make provision for social inclusion as well as accessibility and affordability at the same time.

7. CONCLUSION

What drives the energy decisions of a household in a low-income setting is a matter of interplay between a number of factors: the cost and ease of access, the level of awareness, how technology is received and the backing of policy. The present study shows that making the move to sustainable energy is not simply a case of having clean technologies on hand; it calls for an inclusive way of doing things that takes into account the economic and social position of the more vulnerable. With its integrated mix of community participation, education and technology, the Household Energy Transition Equity Framework (HETEF) we put forward is a means of better comprehending and enhancing those decisions. The work also underlines the need to put in place stronger awareness and improve the infrastructure while cutting down on the financial obstacles so as to open up sustainable solutions to all. We would suggest that subsequent research look to assess community-based renewable models in a range of geographic and socioeconomic settings and examine how household energy behaviour evolves over time.

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