Why do low-income urban dwellers reject energy technologies? Exploring the socio-cultural acceptance of solar adoption in Mumbai and Cape Town

Anika Nasra Haque, Charlotte Lemanski, Jiska de Groot

ABSTRACT

In the global context of reducing carbon emissions and shifting towards sustainable modes of urban infrastructure, strategies that provide decentralized access to renewable energy technologies for the urban poor are increasingly promoted. However, while innovative energy technologies are introduced in order to support global targets for sustainability and service-delivery while also directly benefiting low-income households (e.g. by reducing the monetary costs of energy), there is widespread evidence that low-income urban dwellers do not always readily accept these technologies. Typically, the urban poor are blamed for failing to adopt new technologies, with little consideration for underlying socio-cultural causes. Using examples drawn from qualitative research in low-income settlements in Mumbai and Cape Town, this paper demonstrates the role of socio-cultural attitudes and practices in affecting social acceptance of domestic solar energy interventions. Focusing specifically on perceptions of *normality* and practices of *social capital,* both of which are connected to collective social influence, the paper reveals how these concepts affect the socio-cultural acceptance of new energy technologies amongst low-income urban dwellers in the global South. Furthermore, we argue that adopting a socio-cultural perspective is a crucial, but often overlooked, aspect of scholarly and policy analyses of, and strategies for, energy transitions in the global South.

Keywords: Energy transitions, socio-cultural, social acceptance, normality, social capital, technology diffusion, attitudes and perceptions, Mumbai, Cape Town.

1. Introduction

The contemporary world faces a conflicting challenge: how to extend basic infrastructure to rapidly urbanizing populations while reducing carbon emissions and resource consumption. Within energy infrastructure, the primary response to this challenge has been a dual focus on renewable sources alongside decentralizing models of service provision. This global challenge is particularly acute in cities of the global South, where low-income dwellers typically reside in under- and non-networked serviced settlements on the urban periphery. For example, more than 880 million people in the global South live in settlements that lack access to a reliable and affordable supply of electricity [1]. Decentralised renewable energy technologies are considered to have enormous potential to accelerate the energy transition, because they not only drive action towards low-carbon, inclusive energy systems, but can also be accessed by the poorest segment of the market [2].

The introduction of renewable and decentralised energy technologies at first glance appears a panacea for the provision of universal access to sustainable services in the global South. For governments, it enables the extension of basic infrastructure to urban populations located in inaccessible parts of the city (e.g. due to institutional, policy, legal, land tenure, safety, environmental reasons) without significant increases in emissions; for providers, it facilitates service-delivery at the highly localised scale typically required in low-income settlements (e.g. where unconventional and unplanned buildings are common); while for low-income households, it offers financial savings and immediate access to services that can meet growing demand [3]. Consequently, the provision of renewable and decentralised energy technologies in low-income settlements is an increasing focus for energy actors, policymakers, and researchers. This is hardly surprising given the potential to simultaneously address the environmental and logistical challenges of energy infrastructure delivery in low-income settlements across the rapidly urbanising global South (where grid access is often not possible), while also meeting the energy and financial needs of low-income residents [4]. This latter factor is often cited by policymakers as an expected motivator for the adoption of localised renewable energy technologies by low-income households, predicting that they are likely to be more concerned with personal financial impact than the global environmental impact of new technologies [5]. This has often produced agendas framed by the assumption that low-income households will have positive attitudes towards new energy technologies and will readily accept them. This is despite evidence that a lack of social acceptance and negative attitudes towards new energy technologies are widely experienced in higher-income settings [e.g. 6,7,8,9]. It is therefore hardly surprising that similar trends, whereby socio-cultural attitudes affect renewable energy technology adoption, are evident in low-income settings. And yet, the impact of socio-cultural *attitudes* on energy technology domestic diffusion is frequently overlooked in the literature on low-income contexts in the global South (with the exception of cookstove technology)[1]. Instead, research addresses the socio-cultural environment of energy provision and distribution. For example, Pailman et al.'s [11] recognition of end-user barriers to adopting cookstoves in Southern Africa, Silver's [12] study of material improvisation and social collaboration in Accra; and Lusinga and de Groot's [13] exploration of the attitudes and behaviours of young people towards energy in South Africa. Although these are essential areas of enquiry that draw attention to the human dimension of energy provision and distribution, what remains unaddressed is a deeper insight into how positive and negative attitudes towards technologies are shaped.

Recently, social science perspectives on electrification and energy technology adoption at the domestic scale have begun to explore the non-technical challenges of extending energy-access to low-income urban areas in the global South, recognising for example the role of localised politics [14] and gender dynamics [15] on community and household adoption of new technologies. While this shift away from technological fixes, towards recognising the human-scale of energy adoption, and the need to work with (rather than 'for') local communities in co-designing new technologies (e.g. [16]) are vital, there remain widespread assumptions that poor take-up of new energy technologies amongst low-income urban dwellers is due to weak monetary incentives [17]. We therefore argue that there is an urgent

[1] While we acknowledge that research does exist on the impacts of socio-cultural attitudes on the adoption of new cooking-stoves in the global South (e.g. [10,11]), the energy used for cooking technology is very specific, in comparison to the solar energy discussed in this paper, that can fuel a wide range of domestic tasks (e.g. heating, washing, laundry, cooking) .

need for critical examinations of why human preferences are at odds with 'expert' assumptions. For while there is widespread recognition that socio-cultural norms determine collective acceptance and household adoption of cook-stove technology [19, 20, 21], there is an absence of critical discussion on how this collective culture affects household uptake of new energy technologies more broadly, particularly within Africa [with notable exceptions, 18].

In this paper we argue that this disjuncture – between policy expectations and user attitudes[2] – is in part caused by a lack of critical awareness regarding the socio-cultural dimension of introducing new forms of energy into low-income settlements. To demonstrate this argument, we use the concept of social acceptance, understood as a positive attitude towards energy technologies, which can lead to supporting energy behaviour. Socio-cultural attitudes derive from both socio-culturally influenced perceptions and experiences, as well as individual assessments within a certain context (e.g. individual aspiration). Social acceptance therefore is informed by the multiple and complex goals (communal and/or individual) that people strive towards. Social interaction plays a core role here, whereby different social groups may develop 'inter-subjectively' shared social attitudes [22]. Hence, both individual and collective socio-cultural drivers require analysis in investigating social acceptance. To achieve this, we employ the lenses of normality and social capital as conceptual tools to better understand low-income dwellers' attitudes towards the introduction of decentralised renewable energy technologies. Normality is a useful marker to analyse human behaviour in the broader context of social functioning because it is an individual attitude that is influenced by collective assumptions and aspirations about social norms; while social capital is as a collective asset derived from conforming to 'shared' social norms (through social interactions).

The paper first introduces and explores the conceptual frameworks of social acceptance, normality and social capital; followed by the methodology and case study contexts, using qualitative data to critically explore how socio-cultural attitudes affect urban dwellers' acceptance of decentralised domestic renewable energy technologies. The two case studies, Mumbai and Cape Town, are both global South cities where rapid demographic expansion has outstripped service provision, and both case studies are new-build public housing for low-income dwellers that include solar-technologies for domestic energy consumption.

2. Conceptual framework

2.1 Social Acceptance

Dominant approaches to energy policy focus on the supply-side of energy (inextricably linked to consumption), with reduced attention awarded to considering the complex ways in which social influences affect everyday energy behaviour at the individual, household and settlement-scale [23, 24], or the ways in which attitudes shape behaviour [25]. Consequently, current energy policies tend to "reproduce the 'status quo' … [by] sustaining

[2] In this paper, attitude refers to individual and/or communal evaluation of an object (e.g. solar technology).

and legitimizing" existing social practices, albeit potentially via new forms of technology (that reduce emissions rather than consumption per se), rather than seeking to understand and/or challenge energy practices themselves [24:53]. In this paper, we argue that in order to understand energy *practices* it is vital to explore the ways in which the social-cultural aspects of everyday lived experiences affect social *attitudes* towards energy. By considering the socio-cultural environment(s) of energy users, and the potential impacts of these environments on the social acceptance of energy technologies (at multiple scales), the paper explores why renewable energy projects that appear to offer positive gains for low-income communities (from the perspectives of policymakers and practitioners) are not always readily accepted by end-users. This research is particularly crucial in the global South context of rapid urbanisation, where delivery of sustainable urban infrastructure to low-income residents is urgent, but where social acceptance of new technologies has been mixed.

We draw on Wüstenhagen et al.'s [26] concept of social acceptance, which distinguishes three broad dimensions of social acceptance: (i) socio-political acceptance, requiring acceptance by key stakeholders and policy actors to create an enabling environment for renewable energy; (ii) market acceptance, requiring market adoption of an innovation, including consumer and investor demand; and (iii) community acceptance, requiring end-user acceptance for specific projects and technologies. While recognising the inter-dependency of all three spheres, this paper primarily addresses 'community' acceptance, and builds on the Wüstenhagen et al. [26] framework by focusing specifically on the role of normality and social capital in understanding individual and collective *attitudes* to energy technologies in the global South as the precursor to *acceptance* per se. This is an area that, to date, has received limited attention. In seeking to understand and engage with low-income dweller's individual and collective attitudes towards social acceptance of energy, utilising concepts of socio-cultural norms and social capital, this study steps into that gap.

2.2 Normality

'Normality' is defined as the descriptive and prescriptive representations of being normal, which sets reference points for behavioural decisions regarding social functioning [27, 28]. Here 'normality' represents a normative concept, where being 'normal' has varied interpretations based on individual and communal perspectives and preferences. Human social behaviour is largely shaped by social norms [29], defined as customary standards for behaviour, attitudes, and beliefs shared by members of a group/community. Social norms govern every aspect of human life, from daily behavioural decisions, to group interactions. Indeed, Durkheim [30] famously asserted that humans require social norms in order to function at the individual and collective scale. Essentially, social norms work as grammar for social interactions, and like grammar they experience temporal and spatial change. However, inconsistent social norms (i.e. not shared by all members, and/or undergoing change) often lead to social unrest and uncertainty [29].

Part of the ambiguity regarding the role of 'norms' in reference to human action derives from confusion over the meaning of the term because it has multiple interpretations [31]. It can refer both to what is commonly *done* (i.e. social practices) as well as what is commonly *approved* (i.e. what is socially sanctioned), each representing a different source of human motivation that differs significantly across space and time. Differentiating between prescriptive (injunctive) and descriptive norms explains why 'norms' are not unilateral or fixed. Prescriptive norms refer to societal standards about behaviour, and descriptive norms refer to what others (e.g. in the group) are doing, and what behaviours are generally accepted in practice [32]. While descriptive norms inform behaviour, prescriptive norms enjoin it [33]. Humans' inclination to conform to prescriptive norms are strongly influenced by an individual's perspective, ideologies, aspirations or idiosyncratic beliefs [34]. Scholars argue that conformation to such norms offers a decisional shortcut for choosing how to behave in a given situation: by simply registering and imitating others' actions [32]. The same behaviour can be prescriptively normative but descriptively non-normative (or vice versa) [33]. For example, female education may be supported by individuals in practice (descriptive norm), in contexts where the broader societal standard (prescriptive norms) opposes female education. In fact, disjuncture between an individual or community's prescriptive and descriptive norms are common (and often the catalyst for change), but typically a source of conflict [35]. Furthermore, it is important to note that in contexts of poverty, normality and its 'pressure' to adjust one's behaviour to what others in a group are doing, can reproduce inequalities and legitimise actively harmful situations (e.g. use of cooking fuels that are a health and environmental hazard) that hinder innovation. By highlighting the importance of normality in determining the adoption of new technologies we are not seeking to reproduce deterministic outcomes, but to reveal the importance of working *with* communities to identify and harness social norms in ways that co-produce outcomes that are accepted by communities and other stakeholders (e.g. the environment, private and public service-providers).

In identifying the relationship between individual and collective norms, there is widespread sociological evidence to demonstrate the influence of norms in motivating and directing human actions [32, 36] alongside recognition that individual actions are heavily influenced by group actions and pressure (often implicit and unwitting) for group conformity [e.g. 29, 35]. Indeed, humans alter their beliefs, attitudes and behaviour to fit into a group (often as part of shifting away from another group), and consequently conformity is connected to social norms. For example, Kaufman [37] identified that energy consumption in the Sacramento Municipal Utility District reduced by 2% when households were given personalized reports rating their energy use compared with their neighbours of similar household size using the same fuel. In other words, once households realised that their energy consumption was higher than their neighbours, they actively reduced consumption. Similarly, Schultz et al. [38] found that household energy use increased after customers were informed that their energy bill was less than their neighbours. This reveals that people have a tendency to conform to, or exceed, the norms of the group, particularly where there are personal benefits (i.e. reduced energy bill and/or reduced guilt over consumption). Arguably, normality functions as a reference point for attitudes and acceptance of change [28]. Consequently, we argue that adopting a social norms perspective can provide a useful heuristic tool to critically explore community-level (individual and communal) attitudes towards energy technologies and projects, as well as the relationship between attitudes and acceptance.

2.3 Social Capital

Social capital is broadly defined as a collective asset generated through shared norms and values, social relationships, mutual trust, and social networks. Bourdieu's definition emphasises social networks, defining social capital as: "... the sum of the actual or potential resources that are linked to the possession of a durable network of more or less institutionalised relationships of mutual acquaintance and recognition—in other words, to membership in a group" [39:248]. Recognising that social networks are important primarily as conduits for other assets in the community (e.g. trust, reciprocity), Putnam [40] famously defined social capital as the features of social organization which form through the trust, shared values and norms among individuals within communities. Crucially, Putnam [40,41] recognised that social capital was necessary for humans to cooperate towards shared objectives. Consequently, his analysis highlighted the importance of *shared* norms and reciprocity between individuals as the facilitating factor for individual and collective productivity (hence social capital is arguably an outcome of normality). This is important because it identifies social capital as necessary for bringing about change. Furthermore, since social capital *requires* relationships with others, then it is these relationships and the collective norms framing them that are essential for societal change. Of course, one person can be a member of multiple groups, whereby a wide range of social norms are shared within and between groups, thereby extending this person's social capital.

Social capital's emphasis on relationships not only relates to connections among group members, but also their role in enabling access to external resources. To analyse this, scholars typically refer to three dimensions of social capital: bonding, bridging and linking capital [41, 42]. The social ties within a group are defined as bonding capital, often formed within homogenous groups and reinforcing internal ties based on shared norms. This bonding capital promotes communication within the group to pursue common goals [42]. Bridging capital is more outward in orientation, functioning to narrow the gaps between different communities by facilitating the sharing of information and resources across communities/groups [41], with the potential to spread new ideas and technologies [43]. It is important to note that bridging capital does not necessarily refer to the ties of one whole community to another, but can tie individuals across social groups (see Portes's [44] demonstration of how social capital enables individuals to attain individualistic goals). Therefore, bridging capital may not involve extensive shared norms (in contrast to bonding capital), and is more associated with 'thin/weak' trust or ties, whereby individuals can access the social network resources of other social groups, e.g. to access information and opportunities. Granovetter [45] refers to the "strength of weak ties" for spreading innovation and achieving social and economic mobility. Hence, bridging capital can spread innovation, ideas or information, whereas bonding capital can strengthen groups. Finally, linking capital extends networks beyond the primary group to external networks that can access other agencies in order to benefit the group, for example, to leverage external resources.

Proponents of social capital argue that individuals and groups with high levels of social capital (i.e. shared norms of trust, reciprocity, and engagement) create networks that can benefit all members. While critics argue that there are dark sides of social capital, for example in isolated homogenous groups/communities where high levels of bonding capital can perpetuate intolerance and social inequality while also reducing bridging capital [46, 47], these cautions still demonstrate the inherent ties between social capital and normality. Social groups are formed based on shared norms (e.g. shared behaviour, attitudes, ideals, beliefs) that create and strengthen social capital (in the context of this study, these norms largely relate to energy attitudes, aspiration and acceptance). Scholars highlight the importance of communication channels and social systems as the key elements of 'innovation' (new ideas, technology or behaviour) diffusion[3] [48]. Social capital provides these communication networks within (bonding) and across (bridging) groups. Although this information sharing is a prerequisite for acceptance and adoption, it does not guarantee adoption. Addressing this, several scholars [48, 49, 50] indicate the importance of social systems, where people are motivated by the experiences of people they trust, and this adds traction to their acceptance and adoption of innovation. Here a connection can be seen between social capital and associated notions of normality with technology uptake/behavioural change. Decision-making regarding innovation adoption is closely correlated with information from trusted people and the social aspiration attached to the new idea, behaviour or technology, both of which are inherently tied to social capital and norms. Hence social capital also provides the context of shared norms (both prescriptive and descriptive) and trust through which individuals are influenced by the experiences/attitudes of people in deciding whether to accept innovation [48, 50]. Thus, individuals' positive or negative attitude towards a new energy technology or project is affected by perceptions of that innovation within the group (normality), and how much individuals trust the group network (social capital). While widely recognised that the heterogeneity of urban contexts dilutes social capital and conformity to social norms [e.g. 41,51], the scale of analysis in this paper is two relatively small public housing projects where beneficiaries were selected based on homogenous population criteria (e.g. income, nationality). Consequently, the pressure to conform to social norms, and the capacity to build social capital, are potentially higher than typically assumed for an urban area [52].

While there have been a handful of studies using social capital to explore community acceptance of renewable energy technologies such as wind farms and bioenergy, these studies focus overwhelmingly on the global North [e.g. 53, 54, 55]. In these contexts, renewable energy is introduced into communities that already benefit from high levels of pre-existing network provision, and thus new technologies are promoted by a broad discourse of environmental altruism rather than by an individual/community demand for energy per se. These studies found that existing social capital plays a key role in enabling communities to disseminate information and resources through bridging capital [e.g. 53, 54], and providing the bonding ties necessary for communities to develop leadership [53].

In this paper, we use normality and social capital as the conceptual lens through which to explore how socio-cultural dynamics affect individual and collective energy attitudes towards the social acceptance of solar energy in low-income settlements. While recognising that other factors also affect social acceptance (e.g. information and awareness, service-provider

[3] Diffusion is the process of communicating new ideas (innovation) among the members of a social system.

engagement), the influence of social-cultural environments (social norms and capital) on attitude and acceptance of new energy technologies, are under-researched, particularly in the global South context.

3. Methodology

Adopting a case study approach, the research uses qualitative data across two public housing projects in Mumbai and Cape Town where low-income urban dwellers were awarded new-build housing by the state, and where solar energy technologies were introduced post- and pre-occupation (respectively). In Natwar Parekh, a slum rehabilitation housing project in Mumbai, the community installed rooftop solar panels; while Joe Slovo, a state-subsidised housing settlement in Cape Town, was part of a government Solar Water Heater project. Comparative approaches are increasingly advocated with urban geography as part of the postcolonial agenda to decentre the global North hegemonic grip on knowledge production. By shifting away from historic models of urban comparison in which a global North 'model' is the comparator for a global South 'example', comparative urbanism explicitly promotes the voices and experience of the global South as valid sources for theoretical innovation, in which a South-South comparison is a legitimate source of knowledge in its own right [e.g. 56, 57]. However, it is important to recognise that comparison-in-practice is messy and uneven [58, 59]. While the case studies share common features, both being public housing projects in rapidly urbanising global South cities with weak networked infrastructure; there are also significant differences in terms of the case studies (e.g. high-rise in Mumbai and single-storey in Cape Town, different housing policy models and energy interventions, different cultural contexts) and the data collection methods. Consequently, while comparison between large cities in India and South Africa can be easily justified; for example, contemporary urbanisation is particularly acute and rapid in Africa and Asia; it is equally important to note that comparisons are not identical. We proceeded inductively, exploring how the differential and distinct case studies reveal similar and dissimilar processes and outcomes that open up new possibilities of understanding the urban condition (also see [58, 59]). By juxtaposing these two cases, our arguments about the role of normality and social capital in acceptance or rejection of solar technology are anchored in empirical contexts that are both comparable and diverse. Nonetheless, the study scale is small, and offers indicative reflections rather than prescriptive outcomes.

In adopting the language of 'community' we recognise the diversity of meaning behind the term, and acknowledge that communities are not socially or spatially bounded. Nonetheless, because the case study examples are state housing projects, there are clear physical and social boundaries that determine collective identity and shared experience, which we refer to as 'community'. In Mumbai this includes households within a single residential building, while the Cape Town 'community' comprises households included in a specific settlement-wide Solar Water Heater project. In both cases, the 'communities' not only share common values, norms and similar socio-economic status (which rendered them eligible for state housing support), but also they are bonded by similar needs and experiences in terms of energy and housing.

Research comprised semi-structured interviews with residents and officials, as well as focus groups with residents, supported by transect walks and observations within each settlement, alongside document analysis (see Table 1). Respondents covered a wide range of demographic identities, but residents in both case studies were primarily low-income working-age (20-50) individuals, with a greater focus on female respondents in Mumbai, and male respondents in Cape Town (see Table 2).

Table 1: Summary of methods across the Mumbai and Cape Town case studies

Methods	**Participant**	**Mumbai**[4]	**Cape Town**[5]
Semi-structured interviews	Residents	7 interviews with household occupants, exploring daily practices, decision-making, energy use and aspirations.	4 interviews with community representatives to explore community participation in the energy efficiency project, and community awareness of energy efficiency.
		5 interviews with members from cooperative societies,[6] exploring communal activities.	
	Officials	3 interviews with high and mid-level government officials responsible for slum rehabilitation, focused on institutional perspectives to energy provision.	6 interviews with government officials at multiple scales (provincial and municipal), to explore the institutional framework for the governance of renewable energy in low-income settlements in Cape Town.
			6 interviews with private-sector developers, to explore their roles and responsibilities within the Joe Slovo project (including community engagement).
Focus Groups	Residents	2 focus group discussions with residents (5 participants in each FG) from each building with solar	0[7]

[4] The Mumbai case study data were collected by Anika Haque.

[5] The Cape Town case study data were collected by Joost Sissingh (see ref. [60]), as part of a graduate research project supervised by Jiska De Groot.

[6] Cooperative societies are discussed later in the paper, and are the primary form of community representation in SRH.

[7] Although no focus groups were conducted, study results were obtained from the 'Energy efficiency and sustainable settlements for the N2 Gateway Joe Slovo 3 Precinct – Lessons Learnt Report for the Department of Human Settlements, South Africa', published by Sustainable Energy Africa in 2014 (see [61]).

		panels, exploring various aspects of communal ties, activities, and social capital.	
Transect walks/ community observations		Multiple, to observe physical housing characteristics (e.g. size, number and location of doors and windows, light and ventilation practices, use of other electrical appliances) and to triangulate other data	Multiple, to observe the community's physical and social characteristics (e.g. use of solar water heater, social practices, social interaction, communal activities), and engage in informal conversations with residents.
Document analysis	Reviewing relevant policy documents, project reports, media articles, community newsletters and existing research, in order to position the studies in the wider policy and research fields, and to triangulate primary data.		

Data were analysed using qualitative hand-coding techniques to identify core themes and experiences, which were subsequently compared across the two case studies. While the methods were relatively similar across the two case studies, because different researchers as part of different projects conducted research in each city, there are differences, as demonstrated in Table 1.

Table 2: Social demography of interviewed households (HH) and community representatives (CR) in Mumbai and Cape Town

Location	Respondent	HH size	Age	Gender	Education
Mumbai	HH1	5	28	F	Secondary School
	HH2	6	37	F	Primary School
	HH3	5	32	F	Primary School
	HH4	8	45	F	No formal education
	HH5	5	35	F	Secondary School
	HH6	6	42	F	No formal education
	HH7	5	30	F	Primary School
	CR1	5	38	M	Graduate
	CR2	6	35	M	College
	CR3	5	35	F	Secondary School
	CR4	4	32	F	Secondary School
	CR5	5	40	M	Secondary School
Cape Town	CR6	n/a	21-40	M	n/a
	CR7	n/a	21-40	M	n/a
	CR8	n/a	41-60	M	n/a
	CR9	n/a	21-40	F	n/a

4. Community-run solar panels in Mumbai's 'slum rehabilitation' housing

India has one of the most ambitious renewable energy programmes in the world, aiming to install 175 GW of renewable energy capacity by 2022, largely from solar and wind [62]. However, despite widespread recognition that urban poverty affects approximately one-quarter of the population [e.g. 63, 64], there is little explicit recognition of the specific energy needs of the urban poor. For example, national programmes to extend basic infrastructure to the poor exclude energy (focused on shelter, water supply and sanitation) [65]. Furthermore, there is no official recognition of the link between urban poverty alleviation and energy access, and no specific initiatives to address urban energy poverty. For example, the Integrated Energy policy [66] does not distinguish between the energy needs of the urban and rural poor, and Slum Rehabilitation Housing (SRH) programmes, Mumbai's flagship policy for ending urban poverty, do not include energy subsidies for occupants (former slum-dwellers) facing electricity charges for the first time. This is important because, in cities like Mumbai, one-third (35%) of the population are energy poor [67].

In Mumbai, India's most populous mega-city, the demand for housing far outstrips capacity, and consequently up to half of the city's population reside in slums [68]. To address this challenge, and to meet national objectives to provide adequate housing to all citizens by 2022 [69], the government of Maharashtra created the Slum Rehabilitation Authority (SRA) [70]. Under the SRA's Slum Rehabilitation Housing (SRH) programme, slum dwellers are moved to private-sector constructed formal housing (provided at no cost to occupants).

The case study, Natwar Parekh colony (Figure 1), is a SRH project constructed in 2005, comprising 59 eight-storied buildings that accommodate 4800 households in small (225sq ft/21 sqm) self-contained units. Each building elects a cooperative housing society from resident households (mandated by SRH policy), responsible for building maintenance and communal concerns. Cooperative societies play a key role as the primary communication conduit between communities and external institutions (public and private), both for communities to share grievances as well as for authorities to disseminate information.

Figure 1: Natwar Parekh Colony (photograph taken by Anika Haque, 2018)

Energy efficiency and sustainability are not part of SRH policy aims or architectural design. Indeed, government officials from the SRA stressed that their sole concern and responsibility is the rehabilitation of slum households to formal housing; exemplified by a comment from a high-level SRA official:

"government has given them a free house with all the basic services, what else they need?... we cannot take care of their household cost or their social concerns...this is not our responsibility...".

However, while SRH units were not designed to meet energy efficiency or sustainability goals, nonetheless, their design *does* affect households' energy patterns and costs. Specifically, the small number and size of windows, alongside their sliding design (opening to a 50% capacity) affects energy demand. While SRA officials justified the window design and size as necessary to maintain low construction costs, for residents the absence of sufficient natural ventilation and lighting had financial penalties. Occupants reported heavy reliance on artificial light and ventilation to perform daily household activities. Unsurprisingly therefore, households reported increased energy costs since moving to SRH. While expected that households' energy costs would rise with the shift away from illegal connections in slums (where payment is a lump sum per connection) to demand-based tariffs in formal housing, energy costs comprise a significant proportion of SRH household expenditure. Most households reported a three/four-fold increase in electricity costs, and all the surveyed households' energy costs comprised more than 10% of household income (an indicator for energy poverty). In this context, where households face multiple financial burdens of formal housing (e.g. transportation from peripheral SRH locations, property tax, maintenance bills), households sought strategies to reduce energy costs.

In two of the surveyed buildings, cooperative societies installed solar panels on the building roof (Figure 2), using the electricity generated to meet communal energy needs such as lighting in common spaces, pumping water, and lifts. This is an example of community-led renewable energy installation where social capital was crucial to the process. Cooperatives used bonding capital to work collaboratively in identifying strategies to reduce communal energy costs based on mutual trust and collective expectations. Furthermore, linking capital was essential to access technical information and support from networks outside each building's community of occupants. In this case, cooperatives collaborated with a local NGO (Slum and Shack Dwellers' International) and an international donor (SIDA) who were working on a pilot project for solar technology. The primary motivation for installing the rooftop solar was economic rather than environmental (this echoes existing studies, e.g. [3],[5]), and residents indicated that communal electricity bills reduced to zero following the rooftop solar installation (previously, every household incurred a monthly INR 400 (USD 5) charge for common electricity bills). While the installation and initial maintenance was undertaken by the NGO, subsequently young women from the building were trained to take over the maintenance as volunteers. There were significant time commitments and financial costs attached to this community-based management, e.g. maintenance costs, and adoption was therefore reliant on high levels of mutual trust and reciprocity between households in each building, as well as support for decision-makers in the cooperative society. As expressed by a focus group participant,

"….we have elected our cooperative society to represent us…to look after us…we trust that whatever they decide is for our good…we are together".

This research was undertaken after one year of the technology being community-run and maintained, and all household respondents expressed widespread satisfaction with both the technology and the community-led maintenance.

Figure 2: Solar panels installed on the rooftop of the buildings in Natwar Parekh Colony (photograph taken by Anika Haque, 2018)

Unsurprisingly therefore, these households shared their positive experiences of solar technology with the wider SRH community (i.e. those living in other buildings), and consequently three more buildings decided to install rooftop solar technology. That these three buildings were those where a significant number of households were rehabilitated from the same slum as the earlier two buildings, reveals the importance of bridging capital in facilitating the uptake of solar across new buildings. Although residents were rehabilitated more than a decade ago, the shared norms, trust and networks between people whose life trajectories shared a common path and identity, was crucial in convincing SRH residents to replicate the technology of their former neighbours. This resonates with the "strength of weak ties" [45] discussed earlier, where social (bridging) capital was a primary driver for the uptake of solar technology across different SRH buildings. The presence of cooperative societies is also a crucial factor, providing a mechanism for mobilising community resources, sharing mutual concerns, and accessing external support. In effect, in the Mumbai case, SRH cooperative societies functioned as an institutional framework that facilitated the collection and use of social capital. Furthermore, this example of community-driven adoption and maintenance of solar technology is situated in the broader context of limited state support for residents' lives post-occupation, aptly noted by a resident (CR3),

"government does not help us, they think that they have done it all by giving us the house…they are not ready to even listen to our problems….hence, we have to help ourselves…and we cannot do anything alone…we have realized that together we have greater strength….".

In addition, it was evident that normality was a crucial motivator for households' changing energy behaviours. Several households had purchased new electrical appliances since moving to the SRH, such as air conditioners and washing machines (Figure 3) despite no increase in income. The motivations for purchasing new appliances were not only to meet the demands of a changed physical environment, but also in order to demonstrate the prescriptive norms of formal living. For example, even though they might not use air conditioning frequently, many households purchased (or aspired to purchase) air conditioning in order to be visibly distinct from those who are poor and living in informality. As commented by a low-income household owning an air conditioner (HH5),

"…we are not anymore living in slums, but living in a proper legal building…now we have to adjust our lifestyle with this change…people cannot tell us anymore that we are poor…".

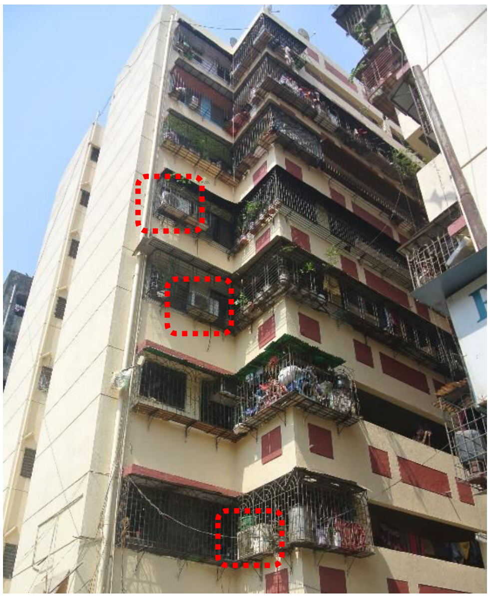

Figure 3: Multiple installed air conditioning units in Natwar Parekh Colony (photograph taken and annotated by Anika Haque, 2018)

In this context, normality is about conforming to wider societal standards or norms about the expectations of non-poor lifestyles in formal housing. It is widely acknowledged that the shift from informal to formal housing brings added pressures to perform an identity of "respectability" that frequently manifests in increased ownership of appliances, often without the capacity to finance the electricity needed to generate them [e.g. 71]. Social acceptance of solar technology is therefore influenced by households' normative desire to function within the perceived standards of a formal household.

While the Mumbai case demonstrates the role of social capital and normality in enabling low-income communities to accept new forms of solar technology in the absence of state-support, the South African case presents a different scenario, where a solar technology provided by the state was not accepted by the community.

5. State-provided solar water heaters in Cape Town's state-subsidised housing

South Africa's cities, accommodating two-thirds of the population [72], are highly dependent on coal, which generates 77% of electricity [73]. The post-apartheid state has adopted a pro-poor policy towards energy access and affordability, alongside more recent shifts towards a low-carbon future. However, apartheid legacies continue to affect inequitable access to energy within cities [74]. For example, while post-apartheid redistribution has extended the electricity network to virtually all urban households (96%), the quality (service interruptions) and affordability of services are problematic, particularly for the urban poor [75]. Since 1994, the South African Government has prioritised the provision of subsidised housing and services (including electricity) to previously disadvantaged communities; for example the National Housing Programme provides homeownership of a newly constructed fully-serviced property (with networked water, electricity, sanitation, refuse collection) for eligible households;[8] and the municipal provision of Free Basic Services (FBS) subsidises networked services to under-serviced communities and indigent households.[9] While the South African government has promoted universal electrification, it has only very recently begun to actively implement strategies for transitioning to renewable energy sources at the household scale [61, 76].

The case study is a public housing development in Joe Slovo, established as an informal settlement in the 1980s on slithers of empty land between Langa (Cape Town's oldest surviving township) and the N2 highway. The Joe Slovo settlement was characterized by extreme poverty, unemployment, and poor living conditions [61]. In 2004, the N2 Gateway Housing project was launched – a flagship national project to deliver up to 25,000 housing units for low-income dwellers along the N2 highway, using sustainable technology through a public-private partnership between government (national, provincial, municipal), a private developer (Sobambisana), and a research partner [61, 77].[10] Phase 3 of the Joe Slovo N2 project comprises delivering homeownership of 2886 subsidised houses to eligible residents of the area (see footnote 8) [61, 77, 78]. These houses are double-storey (to achieve higher densities) and include Solar Water Heaters (SWHs), to promote sustainable energy technology [78]. This represents significant divergence from state-subsidised housing delivered across the country over the prior two decades, which are predominantly single-storey units in low-density settlements on the urban periphery, with standard electricity connections but no hot water storage. Furthermore, although houses are connected to electricity, most residents are dependent on the Free Basic Electricity[11] subsidy to access electricity. This subsidy, however, is rarely sufficient to fulfil household energy needs. A project steering committee (PSC) was established by the Housing Development Agency (HDA) and Department of Human Settlements, comprising 12 elected community representatives, to serve as the link between the community and HDA. In addition to the PSC,

[8] Eligibility criteria include: monthly household income below ZAR 3500 (approx. USD 200), South African nationality, to be married or have a dependent, to have not previously owned property/received a housing subsidy.

[9] The criteria to qualify as an indigent household varies according to location and infrastructure sector, but in the City of Cape Town it is determined by property value below R300,000 (approx. USD 17,250) or household income below R3500 pcm (approx. USD 200) [77].

[10] There have been multiple controversies and court cases related to the N2 Gateway Housing project – e.g. alleged corruption, allocation of housing, public consultation, relocation of prior residents, and the quality of housing – these are recognised, but beyond the scope of this paper.

[11] The provision of Free Basic Electricity (FBE) varies according to the municipality, and operates on a sliding scale according to household consumption. In the City of Cape Town, households who are indigent and low electricity users (defined as households consuming below 250 kWh per month) receive the first 60 kWh of their monthly consumption at no cost (data from interviews with officials, 2018–2019).

two Community Liaison Officers (CLO) were elected by the community to liaise between the community and the wide range of macro-level authorities involved with the project.

The installation of the SWHs in Phase 3 aimed to improve residents' quality of life via physical health and mental well-being, household income (saving electricity costs) and livelihood opportunities (poverty alleviation), as well as improving energy efficiency [76]. The SWH programme was jointly funded by the Danish International Development Assistance Agency (DANIDA), who donated the technologies, and the Western Cape Provincial Government's (WCPG) Department of Human Settlements (which was also the implementing agency). Although a number of other actors were involved including Sustainable Energy Africa (project leaders), the Housing Development Agency (HDA) (project manager), the National Department of Human Settlement (NDoHS) and the community of Joe Slovo [61], the SWH programme remained overwhelmingly driven by the delivery of technology rather than by the process of delivering an energy service, which in part influenced its weak community acceptance. Although the project set out to implement 2886 SWHs in Joe Slovo, it only managed to install 1572 (figure 4) [79], and the absence of bottom-up public participation is widely identified as an important contributor [78]. The Joe Slovo housing project as a whole (including the SWH component) faced criticism from a range of stakeholders from project inception for being largely top-down and lacking community engagement, recognition and transparency [80,81].

Figure 4: Solar water heaters installed on housing units as part of the Joe Slovo SWH project (photograph taken by Sayd Kusai, 2019)

However, analysing the SWH project through the lens of normality and social capital reveals new insights. First, the PSC and CLOs, although elected by the community, were not elected via a community-led process that drew on bonding capital and shared norms. Instead, the process was driven externally and instituted when public engagement of the upgrading programme was already facing significant criticism. Second CLO/PSC members were widely distrusted within the community. Specifically, they were accused of corruption and collusion with authorities, and of using their position to further their own self-centred agendas rather than promoting wider community needs based on shared norms [also see 82]; as acknowledged by one PSC member (CR9), *"During the project I decided to move out of the PSC...the problem was that the PSC was not accommodating the community, instead they took advantage of their positions as PSC so it would be beneficial for themselves."*

The community's lack of trust towards the CLO and PSC members has been documented also by other sources (e.g. SEA [61] and other interviewees). Furthermore, because the community's representation was not shaped through bonding capital or shared norms, the capacity of the community to build linking capital was low. Links between the community and the (multiple) external agencies involved were driven by the latter, whereby community members were viewed as passive beneficiaries rather than active agents. Unlike the Mumbai case study, where the community built on its bonding capital to secure funding and support from external agencies (i.e. linking capital), the process was reversed in the Cape Town case. The community of Joe Slovo became purely the receiver of the *product*, rather than participants in the *process*. To illustrate, the community was informed about the SWH programme only after the project design had been completed, when general information sessions informed the community about project implementation, including the use and benefits of the technology [60]. No community views were sought regarding the suitability or appropriateness of the SWH project to fulfil their needs, and there was no recognition that the community's needs might differ from the external agencies' agenda [78]. Furthermore, the CLOs/PSC members indicated that their role was nominal, characterised by in-frequent meetings with authorities and a lack of interest in genuine community engagement [60]. As mentioned by a PSC member (CR8):

"The way the authorities are managing this project is that they are just doing what they want. They don't listen to the community."

Unsurprisingly, as a consequence of the community's weak engagement in the process, and a focus on technology-driven top-down interventions rather than on process-driven community-based access to services, there was low social acceptance of the SWH product. This resonates with other studies that identify the active participation of end-users in the technology deployment process as vital for social acceptance (e.g. 7, 8, 82, 83). Furthermore, as perceptions of specific technology can have a profound effect on acceptance [83], it is also necessary to consider how peer groups and broader socio-cultural norms affect social acceptance. To illustrate, for those households who did receive a SWH, bridging capital played a crucial role in spreading negative attitudes towards the technology within the community, as SWH households shared their experiences. Because households were awarded technology without a participatory process, SWH households realised over time that the technology did not match either their needs or expectations. After the initial euphoria about the new house and its features wore off, households reported problems with the SWH technology installed. For example, the consistency of hot water (e.g. during cloudy/rainy winter days), and the capacity/size of the SWH system installed (100 litre/day) did not provide sufficient hot water for the household size throughout the year. Because expectations were not managed from the beginning, this created misconceptions about what the technology would be able to achieve, and expectations of the technology that were not realistic. There were also some technological problems experienced with a few of the devices. For example, some SWHs malfunctioned and leaks caused damage to ceilings and walls, and with only a limited guarantee of maintenance, this damaged the reputation of the SWHs as a viable, long-term solution [60,78]. Although only some devices were faulty, SWH households shared their negative experiences within their social group, and already-existing discontent with the engagement process of the settlement upgrading merged with criticisms of the SWH product itself. Social acceptance is not derived primarily through individual feelings and perceived risks and benefits, but is a social process through which individuals and groups influence one another through interaction and shared norms [9, 48, 84].

Furthermore, this collective process is not restricted to shared norms between internal peers within the same community but is also enacted in comparison to other groups. In the Joe Slovo case, an important factor influencing the social acceptance of SWHs was the public perception that they were a sub-standard technology compared to the free-flowing hot water available in wealthy suburban homes in the city (where many Joe Slovo residents work as domestic workers and gardeners) [78]. Many residents viewed SWHs as a 'welfare' technology for poor people that demonstrated a lack of equal service provision across all communities. This is particularly acute in South Africa where the legacies of apartheid ensure that large houses with modern appliances are juxtaposed against cramped informal dwellings with poor access to basic services. Consequently, the prescriptive norm that Joe Slovo residents aspire to is not a technology (SWHs) reserved for the poor, but rather, the standards found in wealthy suburban houses where free-flowing electricity, hot/cold water and sanitation is the norm. This is arguably a direct consequence of expectations created by promises during the demise of apartheid and early post-apartheid efforts to build the 'new' South Africa on equality and prosperity for all, and is reflected in interviews with government and NGOs:

"...there is a narrative generated in such settlements that these solar technologies are the second-grade technologies" (Mid-level NGO official).

"...there are many times, when we have offered the communities alternative (energy) solution but they rejected...even if they don't have access to grid connection" (High-level government official).

This highlights how acceptance of the technology was influenced by perceptions of normality beyond the community itself, i.e. the capacity to function within the assumed broader energy behaviour norms of society. What this demonstrates is that existing community practices (e.g. heating water with kettles/stoves) are *not* perceived as a norm, but as a temporary exception or a remnant of the apartheid era, and that the norm is the gold standard of energy technology seen in higher-income communities. Furthermore, in addition to normality being a marker that extends beyond the specific community, the absence of mutual trust not only within the community (i.e. between residents and the PSCs/CLOs) but also between the community and external agencies was also a core factor in the low acceptance of SWHs in Joe Slovo. While trust and participation are reported in other cases [e.g. 82, 85], illustrating how communities' willingness to accept new technologies is influenced by perceived inequities in the process, this is particularly acute in South Africa given the legacies of apartheid in unequal service provision.

The Cape Town case study demonstrates the role of perceived normality and practices of social capital in explaining why Joe Slovo residents demonstrated low acceptance of SWHs despite full subsidies requiring no upfront financial costs. This is remarkably different from the Mumbai case where similarly well-organised communities used their social capital to build on mutual trust (bonding capital) and support from external agencies (linking capital) in order to self-finance the provision and maintenance of solar technology. In the following section, we discuss some of the reasons for these divergent outcomes.

6. Why do low-income urban dwellers accept or reject energy technologies?

As the two case studies demonstrate, urban dwellers' social acceptance of energy technologies is affected by a myriad of complex reasons. However, it is evident across both cases that perceptions of normality and practices of social capital affect the social acceptance of solar energy technologies. The primary difference between the Mumbai and Cape Town case is the driver for introducing the new technology; in Cape Town, the top-down intervention lacked thorough consideration of the community's needs and aspirations, resulting in low social acceptance, while the Mumbai case shows how a bottom-up initiative derived from common energy needs was successfully executed and subsequently adopted by similar communities. Both cases demonstrate how each community used their bonding capital to mobilise collectively to accept or reject solar technology based on shared identities and mutual trust. The Mumbai community used linking capital to mobilise resources from external agencies; and both communities demonstrated bridging capital in sharing their experiences across communities in order to encourage acceptance (Mumbai) or rejection (Cape Town) of the technology.

Both the case studies demonstrate how low-income urban dwellers function within a normative ideal of energy behaviour that matches wealthier residents' houses and lifestyles. In the Mumbai case study, the desire to perform this normative ideal resulted in households purchasing new appliances and adopting different energy behaviours irrespective of whether it was affordable or relevant to their household needs. This is identified in other studies in India, noting that after moving to an SRH community, households would purchase higher-cost brands and larger-sized appliances, compared to non-brand appliances purchased when previously living in slums [86, 87], as part of the perceived upward mobility of rehabilitation to formalized housing [88]. Despite a different outcome, in Cape Town, the community were equally influenced by normative expectations of matching affluent energy behaviours, and therefore demonstrated negative attitudes towards the technology that was, once the novelty wore off, perceived as a welfare tool designed exclusively for the poor. In South Africa, SWHs are predominantly seen in low-income communities (despite widespread adoption in other parts of the world), and the community's negative attitudes towards SWHs were framed by the technology's inability to allow end-users to perform the normative energy lifestyles of their aspiration, rather than outright rejection of the technology per se. This is particularly acute in South Africa where low-income aspirations are framed by the historic and socio-political trajectories of segregation and inequality, in contrast to the 'individual' aspiration for social mobility in Mumbai. Nonetheless, both cases demonstrate how low-income households respond to prescriptive norms about the energy behaviours (and associated technologies) deemed suitable for living in formal housing. Households were willing to make huge financial sacrifices and reject new technologies that came with zero upfront costs (and had the potential to bring financial savings), in order to demonstrate to their peers that they 'fit' into their new identity as formal homeowners. This reveals how conformity to (perceived) social norms affects energy behaviour and technology acceptance, and demonstrates how the standard for 'normality' can be set by the perceived behaviour and lifestyles of another (in this case, wealthier) group. Consequently, in order to understand why low-income dwellers accept or reject energy technologies it is vital to consider the wider socio-cultural environment that determines perceptions of normality.

Arguably, these cases demonstrate that practices of social capital and perceptions of normality affect the social acceptance of innovation/technology for low-income urban dwellers. In practice, social norms and social capital overlap, across both households and communities, whereby normality is generated from community affiliation [29, 35]. For example, in the Mumbai SRH, (descriptive) norms derived from social capital whereby households rehabilitated from the same slums share similar normative ideals based on mutual trust (e.g. the spread of solar technology to new SRH buildings). Furthermore, social capital reinforces shared (descriptive) norms, as households conform to group expectations for the acceptance/rejection of energy behaviours or technologies. For example, in Cape Town, while many households recognised some of the benefits of using solar technology, social acceptance of SWHs was negatively affected by community reciprocity in accepting the majority decision to reject the technology. In this context, reciprocity demonstrates social affiliation and commitment to the group/community, revealing the influence of existing social capital and social norms (both descriptive and prescriptive) within the community, and also highlighting how social influence can catalyse household energy behaviour [28, 89]. From this perspective, it is evident that social capital and group conformity operate in tandem [90, 91]. Consequently, the deployment of renewable energy technologies in low-income settings needs to start by understanding social-cultural factors in order to identify renewable forms of decentralised energy technology that are likely to secure social acceptance and achieve widespread adoption.

In both case studies, a core explanation for the adoption/rejection of energy technology was that the product provided by the state (SRH in Mumbai, SWHs in Cape Town) did not meet the needs of low-income occupants/users, and that this was partially attributed to the absence of public participation. The SWHs in Joe Slovo did not meet the energy needs (e.g. insufficient water capacity, and hot water at the wrong times of day/season), or expectations of the poor (e.g. mismatch with the standards found in wealthy suburban houses). Similarly, in Mumbai, the cheap sliding windows caused poor natural ventilation and lighting in the SRH that cost households additional expenditure. While there is widespread recognition of the necessity of public participation (rather than consultation) in development projects delivering community-based individualised infrastructure such as housing and/or energy technology [e.g. 92, 93, 94, 95, 96], it is rare that external agencies have the capacity or willingness to engage meaningfully with the messy business of identifying the community's (often conflicting) needs and aspirations. Indeed, in addition to lack of institutional capacity to recognise multiple community voices/needs within and between low-income settlements, municipal authorities (as institutions and individuals) often have their own understandings of 'normality' as applied to expected behaviour and aspirations within low-income settlements, that frequently conflict with urban dwellers' perceptions [97]. In this context, consideration for social capital and the social influence of norms on energy behaviour can provide a mechanism for external agencies to better understand how and why low-income dwellers accept or reject new energy technologies [98]. However, it is important to note that while social acceptance is a vital factor for the adoption of new energy behaviours, it is reliant on communities having access to information and resources necessary to engage meaningfully with the *process* of energy interventions, not just the *product* [98, 99, 100].

7. Conclusion

This paper has used examples drawn from qualitative research in low-income settlements in Mumbai and Cape Town, to demonstrate the role of socio-cultural attitudes and practices in affecting social acceptance of domestic solar energy interventions. Focusing specifically on perceptions of *normality* and practices of *social capital,* both of which are connected to collective social influence, the paper has revealed how these concepts affect the socio-cultural acceptance of new energy technologies amongst low-income urban dwellers in the global South.

We recognise that both 'normality' and 'social capital' as concepts are nebulous and complex, encompassing diverse variables such as conformity, aspiration, reciprocity, and affiliation. However, in using these concepts, we highlight how they contribute to understanding how energy behaviour and adoption of new technology are inherently *socially* driven. This is important because the case studies reveal how social norms can hinder or accelerate the deployment of energy innovations. Consequently, energy innovation, particularly in the context of low-income urban settlements, needs to be conceptualised both as a socio-cultural intervention and a technological or environmental intervention. Accordingly, in order to understand why low-income urban dwellers reject and accept new energy technology, it is vital to understand the broader social norms and capital of the target group, the socio-political environment and other locally relevant dynamics and their socio-political environment. For example, in both Cape Town and Mumbai, the desire to visibly demonstrate affluent energy lifestyles was a core factor influencing the social acceptance of solar energy. Therefore, in the global context where there is the dual urgency to extend infrastructure to the urban poor while simultaneously reducing carbon emissions, it is vital that a socio-cultural perspective is adopted within both scholarly debates and practical interventions.

The findings of this paper have important implications for the policy and practice of delivering energy services. Those involved in the implementation of energy technologies in communities need to take into account that technologies are not only embedded in socio-cultural contexts but are also shaped by perceptions of normality. We therefore recommend that those delivering energy projects and services try to work 'with' the social capital present in the community. Doing this requires an understanding of local social dynamics in addition to site-specific parameters. This further reinforces the importance of engaging communities and end-users in the conceptualisation and rollout of energy projects. This would lead to projects that are not only implemented with less conflict but also respond better to end-user needs and preferences.

References

[1] V. Castán Broto, L. Stevens, E. Ackom, J. Tomei, P. Parikh, I. Bisaga, L. To, J. Kirshner, Y. Mulugetta, A research agenda for a people-centred approach to energy access in the urbanizing global south, Nature Energy, 2 (2017), 776–779. https://doi.org/10.1038/s41560-017-0007-x.

[2] P. Alstone, D. Gershenson, D. M. Kammen, Decentralized energy systems for clean electricity access, Nat. Clim. Change, 5 (2015), 3015–3014. https://doi.org/10.1038/nclimate2512.

[3] A. McCabe , D. Pojani, A. B. Van Groenou, The application of renewable energy to social housing: A systematic review, Energy Policy, 114 (2018), 549-557. https://doi.org/10.1016/j.enpol.2017.12.031.

[4] D.Teli, T. Dimitriou, P. A. B. James, A. S. Bahaj, L. Ellison, A. Waggott, Fuel poverty-induced 'prebound effect' in achieving the anticipated carbon savings from social housing retrofit, Building Services Engineering Research and Technology, 37 (2016), 176-193. https://doi.org/10.1177/0143624415621028.

[5] H. Muyingo, Organizational Challenges in the Adoption of Building Applied Photovoltaics in the Swedish Tenant-Owner Housing Sector, Sustainability, 7 (2015), 3637-3664. https://doi.org/10.3390/su7043637.

[6] P. Devine-Wright, Public engagement with large-scale renewable energy technologies: Breaking the cycle of NIMBYism. Wiley Interdisciplinary Reviews: Climate Change, 2(1), (2011). 19-26. https://doi.org/10.1002/wcc.89

[7] C. Haggett, Planning and persuasion': Public engagement in renewable energy decision-making, in Devine-Wright, P. (eds.), Renewable energy and the public, Earthscan: London, Washington DC, (2011), 15-28.

[8] M. Wolsink, Discourses on the implementation of wind power: Stakeholder views on public engagement, in Devine-Wright, P. (eds.), Renewable energy and the public, Earthscan: London, Washington DC. (2011), 75-88.

[9] J. de Groot, I. Bailey, What drives attitudes towards marine renewable energy development in island communities in the UK? Int. J. Mar. Energy, 13 (2016), 80-95. https://doi.org/10.1016/j.ijome.2016.01.007.

[10] S. P. Astuti, R. Day, S. B. Emery, A successful fuel transition? Regulatory instruments, markets, and social acceptance in the adoption of modern LPG cooking devices in Indonesia. Energy Research & Social Science, 58 (2019), 101248.

[11] W. Pailman, J. De Groot, M. Clifford, S. Jewitt, C. Ray, Experiences with improved cookstoves in Southern Africa, Journal of Energy in Southern Africa, 29(4), (2018), 13–26. https://doi.org/10.17159/2413-3051/2018/v29i4a5072 .

[12] J. Silver, Incremental infrastructures: material improvisation and social collaboration across post-colonial Accra, Urban Geography, 35(6), (2014), 788-804. https://doi.org/10.1080/02723638.2014.933605.

[13] S. Lusinga, J. de Groot, Energy consumption behaviours of children in low-income communities: A case study of Khayelitsha, South Africa, Energy Research and Social Science, 54 (2019), 199-210. https://doi.org/10.1016/j.erss.2019.04.007.

[14] R. de Bercegol , J. Monstadt, , The Kenya Slum Electrification Program. Local politics of electricity networks in Kibera, Energy Research & Social Science, 41 (2018), 249-258.

[15] M. Sunikka-Blank, R. Bardhan, and A.N. Haque, Gender, domestic energy and design of inclusive low-income habitats: a case of sum rehabilitation housing in Mumbai, India, Energy Research & Social Science, 49 (2019), 53-67.

[16] Ambole et al., Mediating household energy transitions through co-design in urban Kenya, Uganda and South Africa, Energy Research & Social Science, 55 (2019), 208-217. https://doi.org/10.1016/j.erss.2019.05.009

[17] A. Figueroa, , L. Molière, A. Pegels, , B. Never, F. Kutzner, Show me (more than) the money! Assessing the social and psychological dimensions to energy efficient lighting in Kenya, Energy Research & Social Science, (2019), 224-232

[18] D. Ockwell, et al, , The uptake and diffusion of solar power in Africa: Socio-cultural and political insights on a rapidly emerging socio-technical transition, Energy Research & Social Science, 44, (2018), 122-129.

[19] S. P. Astuti, , R. Day, , & S. B. Emery, A successful fuel transition? Regulatory instruments, markets, and social acceptance in the adoption of modern LPG cooking devices in Indonesia. Energy Research & Social Science, 58 (2019), 101248.

[20] G., Miller, A. M. Mobarak, Learning about new technologies through opinion leaders and social networks: experimental evidence on non-traditional stoves in rural Bangladesh. Poverty Action, (2013).

https://assets.publishing.service.gov.uk/media/57a08a48ed915d622c000667/Miller-Mobarak-2013-Working-Paper.pdf (accessed October 25, 2020)

[21] G. Miller, A. M. Mobarak, Learning about new technologies through social networks: experimental evidence on nontraditional stoves in Bangladesh. Marketing Science, 34(4), (2015), 480-499.

[22] M. Hitzeroth, A. Megerle, Renewable Energy Projects: Acceptance Risks and Their Management, Renewable and Sustainable Energy Reviews, 27 (2013), 576-584. https://doi.org/10.1016/j.rser.2013.07.022.

[23] K. Parkhill, C. Demski, C. Butler, A. Spence, N. Pidgeon, Transforming the UK Energy System: Public Values, Attitudes and Acceptability: Synthesis Report. London: UKERC, (2013).

[24] E. Shove, G. Walker, What Is Energy For? Social Practice and Energy Demand. Theory, Culture & Society, 31(5), (2014), 41–58. https://doi.org/10.1177/0263276414536746.

[25] S. Owens, L. Driffill, How to change attitudes and behaviours in the context of energy, Energy Policy, 36(12), (2008), 4412-4418. https://doi.org/10.1016/j.enpol.2008.09.031.

[26] R. Wustenhagen, M.Wolsink, M. J. Burer, Social acceptance of renewable energy innovation: An introduction to the concept, Energy Policy, 35 (2007), 2683–2691. https://doi.org/10.1016/j.enpol.2006.12.001.

[27] A. Bear, J. Knobe, Normality: Part descriptive, part prescriptive. Cognition, 167 (2017), 25–37. https://doi.org/10.1016/j.cognition.2016.10.024.

[28] N. J. Roese, K. Epstude, The functional theory of counterfactual thinking: New evidence, new challenges, new insights. Advances in Experimental Social Psychology, 56 (2017), 1–79. https://doi.org/10.1016/bs.aesp.2017.02.001.

[29] S. Gavac, S. Murrar, M. Brauer, Group perception and social norms. In Summers, R. (ed.), Social Psychology: How Other People Influence Our Thoughts and Actions. Santa Barbara, CA: ABC-CLIO. (2017), http://psych.wisc.edu/Brauer/BrauerLab/wp-content/uploads/2017/05/Group-Perception-and-Social-Norms_Gavac-Murrar-Brauer-2016.pdf (accessed 30 November, 2019).

[30] É. Durkheim, The Division of Labor in Society, (G. Simpson, Trans.) New York: The Free Press, (1983), 723 pages.

[31] L. S. Schaffer, Toward Pepitone's vision of a nonnative social psychology: What is a social norm? *Journal of Mind and Behavior,* 4 (1983), 275-294.

[32] R. B. Cialdini, N. J. Goldstein, Social influence: Compliance and Conformity. Annu. Rev. Psychol, 55 (2004), 591–621. https://doi.org/10.1146/annurev.psych.55.090902.142015.

[33] R. B. Cialdini, C. A. Kallgren, R. R. Reno, A focus theory of normative Conduct: a theoretical refinement and reevaluation of the role of norms in human behaviour, Advances in Experimental Social Psychology, 24 (1991), 201-234.

[34] M. Brauer, N. Chaurand, Descriptive norms, prescriptive norms, and social control: An intercultural comparison of people's reactions to uncivil behaviours, European Journal of Social Psychology, 40, (2010), 490-499.

[35] R. I. McDonald, C. S. Crandall, Social norms and social influence Current Opinion in Behavioral Sciences, 3 (2015), 147–151. https://doi.org/10.1016/j.cobeha.2015.04.006 .

[36] M. G. Millar, A. Tesser, The effects of affective-cognitive consistency and thought on the attitude behavior relation. Journal of Experimental Social Psychology, 25 (1989), 189-202.

[37] Kaufman, L. Utilities turn their customers green, with envy, New York Times (2009), https://www.nytimes.com/2009/01/31/science/earth/31compete.html (accessed 3 October, 2019).

[38] P. W. Schultz, J. M. Nolan, R. B. Cialdini, N. J. Goldstein, V. Griskevicius, The constructive, destructive, and reconstructive power of social norms. Psychol Sci, 18 (2007), 429-434. https://doi.org/10.1111/j.1467-9280.2007.01917.x .

[39] P. Bourdieu, The forms of capital. In: J. G. Richardson. Handbook for Theory and Research for the Sociology of Education. (1986) Westport, CT: Greenwood Press, 241 – 258.

[40] R. Putnam, The prosperous community. American Prospect, 13(4), (1993), 35-42.

[41] R. Putnam, Bowling Alone: The collapse and revival of American community. New York: Simon and Schuster, (2000), 544 pages.

[42] M. Woolcock, The place of social capital in understanding social and economic outcomes, ISUMA, 2 (2001), 11-17.

[43] R. Crescenzi, L. Gagliardi, M. Percoco, The 'bright' side of social capital: how 'bridging' makes Italian provinces more innovative, in Crescenzi, R and Percoco, M (eds). Geography, Institutions and Regional Economic Performance, Springer: Berlin, (2013), 143-164.

[44] A. Portes, Social capital: its origins and applications in modern sociology. Annual Review of Sociology, 24 (1998), 1–24. https://doi.org/10.1146/annurev.soc.24.1.1.

[45] M. S. Granovetter, *Getting a job: A study of contacts and careers*, 2nd Edition (1995), Boston, MA: Harvard University Press, 259 pages.

[46] F. Fukuyama, Social Capital and Development: The Coming Agenda. SAIS Review 22(1), (2002), 23-37. https://doi.org/10.1353/sais.2002.0009.

[47] J. W. Deth, S. Zmerli, Introduction: Civicness, Equality, and Democracy- A "Dark Side" of Social Capital? American Behavioral Scientist, 53(5), (2010), 631-639. https://doi.org/10.1177/0002764209350827.

[48] Rogers, E.M. Diffusion of Innovations. Free Press, New York, London, (2003), 551 pages.

[49] J.W. Dearing, Evolution of diffusion and dissemination theory. *Journal of Public Health Management and Practice*, 14 (2), (2008), 99–108. doi: 10.1097/01.PHH.0000311886.98627.b7.

[50] M. McMichael, D. Shipworth, The value of social networks in the diffusion of energy-efficiency innovations in UK households, Energy Policy, 53 (2013), 159–168. https://doi.org/10.1016/j.enpol.2012.10.039.

[51] D., Mpanje, P. Gibbons, R. McDermott, Social capital in vulnerable urban settings: an analytical framework. Journal of International Humanitarian Action, 3(4), (2018) https://doi.org/10.1186/s41018-018-0032-9.

[52] S. S. Brehm, S. M. Kassin, Social Psychology, (1996) Boston, MA: Houghton Mifflin Company.

[53] C. von Bock und Polach, C. Kunze, O. Maaß, P. Grundmann, Bioenergy as a socio-technical system: The nexus of rules, social capital and cooperation in the development of bioenergy villages in Germany, Energy Research & Social Science, 6 (2015), 128-135. https://doi.org/10.1016/j.erss.2015.02.003.

[54] P. Devine-Wright, , P. Fleming, H. Chadwick, Role of social capital in advancing regional sustainable development. Impact Assessment and Project Appraisal, 19(2), (2001), 61-167. https://doi.org/10.3152/147154601781767096.

[55] C. Anderson, J. Schirmer, An Empirical Investigation of Social Capital and Networks at Local Scale through Resistance to Lower-Carbon Infrastructure, Society & Natural Resources, 28(7), (2015), 749-765. https://doi.org/10.1080/08941920.2015.1014599.

[56] J. Robinson, Thinking cities through elsewhere: Comparative tactics for a more global urban studies, Progress in Human Geography, 40 (2016), 3-29. https://doi.org/10.1177/0309132515598025.

[57] C. Lemanski, 'Comparative Urbanism'; in Audrey Kobayashi (Ed.), International Encyclopedia of Human Geography (2nd edn), 14 (2020), 131-134.

[58] T. P. Caldeira, Peripheral urbanization: Autoconstruction, transversal logics, and politics in cities of the global south. Environment and Planning D: Society and Space, 35(1) (2017), 3-20. https://doi.org/10.1177/0263775816658479

[59] S. Lazar, Disjunctive comparison: citizenship and trade unionism in Bolivia and Argentina, Journal of the Royal Anthropological Institute, 18(2) (2012), 340-368. https://doi-org.ezp.lib.cam.ac.uk/10.1111/j.1467-9655.2012.01747.x

[60] J. Sissingh, Energy efficiency interventions in the low-income housing sector of South African cities: an institutional analysis of a sustainable housing project in Joe Slovo, Cape Town, Unpublished thesis, Vrije Universiteit Amsterdam, (2017).

[61] Sustainable Energy Africa, Energy efficiency and sustainable settlements for the N2 Gateway Joe Slovo 3 Precinct – Lessons Learnt Report for the Department of Human Settlements, South Africa, (2014), http://sustainable.org.za/sustainable.org.za/uploads/files/file79.pdf (accessed 20 February, 2020).

[62] IRENA, Remap renewable energy prospects for India (2017), https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2017/May/IRENA_REmap_India_paper_2017.pdf (accessed 15 October, 2019).

[63] UNDP India, India: Urban Poverty Report 2009, (2009), https://www.undp.org/content/dam/india/docs/india_urban_poverty_report_2009_related.pdf (accessed 15 November, 2019).

[64] A. Revi, S. Sen, G. Jain, K. Wankhade, S. Anand, UNDP: India Urban Poverty Strategy (2013-17), Indian Institute for Human Settlements, (2014). https://doi.org/10.24943/undpiups2013.2017.

[65] GNESD, Country report (India): Energy poverty in developing countries' urban poor communities: assessments and recommendations. Urban and Peri-urban energy access III. The Energy and Resources Institute (TERI) (2014), https://in.one.un.org/wp-content/themes/un-india/pdf/country-report-2014-india.pdf (accessed 24 November, 2019).

[66] Integrated Energy Policy, Planning Commission, Government of India (2006), https://niti.gov.in/planningcommission.gov.in/docs/reports/genrep/rep_intengy.pdf (accessed 16 June, 2018).

[67] SPARC, (2015) Energy justice for the urban poor. https://sparcindia.org/pdf/studies/EnergyJusticefortheUrbanPoorgraphicalReport_webversion.pdf (accessed 20 January, 2020).

[68] Cities Alliance, Slum upgrading up close: experiences of six cities, (2008) Wasington DC. https://citiesalliance.org/index.php/resources/knowledge/cities-alliance-knowledge/slum-upgrading-close-experiences-six-cities (accessed: 10 February, 2020).

[69] R. Bardhan, S. Sarkar, A. Jana, NR. Velaga, Mumbai slums since independence: Evaluating the policy outcomes; Habitat International, 50 (2015) 1–11. https://doi.org/10.1016/j.habitatint.2015.07.009.

[70] SRA, Govt. of Maharashtra, Slum Rehabilitation Scheme – SRP/1095/CR37/Housing Cel, (1995), http://sra.gov.in/page/innerpage/about-us.php (accessed 18 July, 2019).

[71] F. C. Ross, Model Communities and Respectable Residents? Home and Housing in a Low-income Residential Estate in the Western Cape, South Africa, Journal of Southern African Studies, 31(3), (2005), 631-648, https://doi.org/10.1080/03057070500203038.

[72] UN 2018 United Nations (UN), World Urbanization Prospects, (2018), https://population.un.org/wup/ (accessed 15 November, 2019).

[73] ESKOM, Coal power, (2020) Available online at: http://www.eskom.co.za/AboutElectricity/ElectricityTechnologies/Pages/Coal_Power.aspx, (accessed 10 July, 2020).

[74] S. Essex, J. de Groot, Understanding energy transitions: The changing versions of the modern infrastructure ideal and the 'energy underclass' in South Africa, 1860–2019. Energy Policy, 133 (2018). https://doi.org/10.1016/j.enpol.2019.110937 .

[75] I. Palmer, N. Moodley, S. Parnell, Building a Capable State: Service Delivery in Post-Apartheid South Africa. London, ZED Books, (2017).

[76] Sustainable Energy Africa, Sustainable energy solutions for South African local government: a practical guide (Cape Town: Sustainable Energy Africa), (2017), https://www.sustainable.org.za/userfiles/solar%20water%20heating(2).pdf (accessed 20 February, 2020).

[77] K. Tissington, N. Munshi, G. Mirugi-Mukundi and E. Durojaye, 'Jumping the Queue', Waiting Lists and other Myths: Perceptions and Practice around Housing Demand and Allocation in South Africa, University of the Western Cape and Socio-Economic Rights Institute of South Africa, (2013), 99 pages.

[78] R. Koster, Participatory Governance in Cape Town: An insight into the policy domain of solar water heaters for low-income areas, Unpublished Thesis, Geography, Planning and Environment (GPM) Faculty of Management, Radboud University Nijmegen, (2018).

[79] National Department of Human Settlements. (2014). The N2 Gateway Project: Joe Slovo Phase 3 Low Income Housing Development: Sustainable Housing Delivery Lessons learnt. South Africa: National Department of Human Settlements.

[80] Phuhlisani, *Learning from Joe Slovo: NCHR workshop on advancing socio economic rights.* Cape Town, (2009), http://www.phuhlisani.com/oid/downloads/Learning%20from%20Joe%20Slovo%20V%2004.1%2025Aug09.pdf (accessed 9 March, 2020).

[81] GroundUp, *Experts caution government over new housing mega-projects,* (2016), http://www.groundup.org.za/article/not-too-big-fail-experts-caution-government-over-new-housing-megaprojects/ (accessed 12 March, 2020).

[82] C. Gross, Community perspectives of wind energy in Australia. The application of a justice and community fairness framework to increase social acceptance, Energy Policy, 35 (5), (2007). https://doi.org/10.1016/j.enpol.2006.12.013.

[83] A. Mallett, Social acceptance of renewable energy innovations: The role of technology cooperation in urban Mexico, Energy Policy, 35 (2007), 2790–2798. https://doi.org/10.1016/j.enpol.2006.12.008.

[84] I. Ajzen, The Theory of Planned Behavior. Organization Behavior and Human Decision Processes, Academic Press, Inc. (1991) 179-211. https://doi.org/10.1016/0749-5978(91)90020-T.

[85] Huijts et al., 2007 N.M.A. Huijts, C.J.H. Midden, , A.L. Meijnders, Public acceptance of carbon dioxide storage, Energy Policy 35(5), (2007). https://doi.org/10.1016/j.enpol.2006.12.007.

[86] G.M. Eckhardt, H. Mahi, Globalization, consumer tensions, and the shaping of consumer culture in India, J. Macromarketing, 32 (3), (2012), 280–294, https://doi.org/10.1177/0276146712440708.

[87] R. Khosla and A. Chunekar (eds.) Plugging In: A Collection of Insights on Electricity Use in Indian Homes, Research Report, (2017), Centre for Policy Research, New Delhi and Prayas (Energy Group), Pune.

[88] M. Sunikka-Blank, R. Bardhan, A. N. Haque, Gender, domestic energy and design of inclusive low-income habitats: a case of slum rehabilitation housing in Mumbai, Energy Res. Soc. Sci., 49 (2019), 53–67. https://doi.org/10.1016/j.erss.2018.10.020.

[89] E. R. Frederiks, K. Stenner, E. V. Hobman, Household energy use: Applying behavioural economics to understand consumer decision-making and behaviour Renewable and Sustainable Energy Reviews, 41 (2015), 1385–1394. https://doi.org/10.1016/j.rser.2014.09.026.

[90] S. T. Kate, S. Haverkamp, F. Mahmood, Social network influences on technology acceptance: A matter of tie strength, centrality and density, Proceedings of 23rd Bled eConference eTrust: Implications for the Individual, Enterprises and Society, (2010), Bled, Slovenia.

[91] N. S. Contractor, L. A. De Church, Integrating social networks and human social motives to achieve social influence at scale. PNAS, 111(4), (2014), 13650–13657. https://doi.org/10.1073/pnas.1401211111.

[92] Lemanski, C., 2017, 'Unequal citizenship in unequal cities: Participatory urban governance in post-apartheid South Africa', International Development and Planning Review, 39(1), 13-32.

[93] Lemanski, C., 2008, 'Houses without Community: problems of community (in)capacity in a low-cost housing community in Cape Town, South Africa', *Environment and Urbanization*, 20(2), 393-410.

[94] A. Nickson, Where is Local Government Going in Latin America? A Comparative Perspective. Working Paper 6. Visby, Sweden: Swedish International Centre for Local Democracy (2011).

[95] A. Cornwall, V. S. P. Coelho (eds.), Spaces for Change? The Politics of Participation in New Democratic Arenas, University of Chicago Press: USA, (2007), 288 pages.

[96] A. M. Goetz, J. Gaventa, Bringing citizen voice and client focus into service delivery, IDS Working Paper No. 138, Institute of Development Studies, University of Sussex, Falmer, (2001).

[97] C. Lemanski, Infrastructural citizenship: the everyday citizenship of adapting and/or destroying public housing in Cape Town, South Africa. Transactions of the Institute of British Geographers, 45(3), (2020), 589-605. http://dx.doi.org/10.1111/tran.12370.

[98] E. Judson, S. Bell, H. Bulkeley, G. Powells, S. Lyon, The co-construction of energy provision and everyday practice: Integrating heat pumps in social housing in England. Science and Technology Studies, 28 (2015), 26-53. https://eprint.ncl.ac.uk/216196 (accessed 2 November, 2019).

[99] A. Ambrose, User and organizational responses to biomass district heating, Proceedings of the Institution of Civil Engineers: Urban Design and Planning, 167 (2014), 35-41. https://doi.org/10.1680/udap.12.00023.

[100] T. Hoppe, Adoption of innovative energy systems in social housing: Lessons from eight large-scale renovation projects in The Netherlands. Energy Policy, 51 (2012), 791-801. https://doi.org/10.1016/j.enpol.2012.09.026.