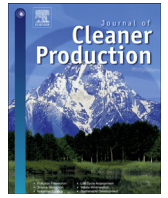


Contents lists available at [ScienceDirect](#)

Journal of Cleaner Production

journal homepage: www.elsevier.com/locate/jclepro

Promoting household energy conservation in low-income households through tailored interventions in Grahamstown, South Africa

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ARTICLE INFO

Article history:

Received 26 October 2015
 Received in revised form
 2 May 2016
 Accepted 4 May 2016
 Available online xxx

Keywords:

South Africa
 Low-income households
 Energy conservation
 Interventions
 Pro-environmental behaviour

ABSTRACT

There is consensus among researchers and policy makers that households are major consumers of energy, which results in serious environmental and financial costs. However, low-income households in particular, are often energy insecure and spend a substantial proportion of their income on energy expenditure. Therefore, promoting household energy conservation is considered one of the key pathways to achieving sustainability, in both environmental and financial terms. This study examines the effectiveness of intervention strategies designed to promote energy conservation using data gathered among low-income households in Grahamstown, South Africa. A total of 103 households participated in the experimental study. Energy conservation strategies including print media, interactive face-to-face discussions and feedback were variably applied to different households. The results show that the interventions were more effective in promoting energy conservation when applied conjointly rather than separately. These results suggest that promoting pro-environmental behaviour even among low-income households is a possibility. Further, household energy reduction had significant relationships with participants' self-reported actions and personal values, but not with demographic characteristics. This study provides useful insights into the complex interplay of personal and situational factors that shape household energy consumption. The study underscores the important role that household-driven programmes could play in promoting sustainable energy use, with support from local (municipal) government.

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1. Energy efficiency in a South African context

Energy is one of the basic requirements for human life and a key resource for development. South Africa has one of the highest rates of access to energy in Africa with nearly 90% of its households connected to the national electricity grid (Department of Energy (2012)). South Africa's public utility ESKOM generates approximately 95% of all electricity used in the country (and 45% of the electricity used in Africa) and plans are underway to build additional power stations and power lines to meet rising demand in various sectors of the economy, such as mining, agriculture, commercial, industrial and residential (ESKOM, 2014). However, despite this seemingly positive outlook on the economy, South Africa is faced with a two-pronged challenge. The country is highly

dependent on fossil fuels, a key source of CO₂ emissions (IPCC, 2007), and more than 90% of its electricity demand is met with coal (UNEP, 2004; ESKOM, 2014). The country is one of the main producers of greenhouse gases and is among the top 20 carbon dioxide emitters in the world (Department of National Treasury (2010)). While considerable progress has been made to provide electricity to all people, special attention has also been paid to provide sufficient electricity to low-income households to meet their daily needs (Winkler, 2006; Department of National Treasury (2010)). Hence, the country's main sustainability challenge is to reduce energy consumption and provide affordable electricity to low-income households (Winkler, 2006).

Comparatively, more studies on energy conservation and efficiency have been conducted for high-income than low-income households. However, given that low-income households have less financial resources to pay for electricity, it is important for them to adopt energy conservation behaviour. Energy conservation behaviour is herein defined as any engagement in actions aimed at reducing energy consumption. Low-income households often

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spend a disproportionate portion of their income on energy expenditure (Bird and Hernández, 2012). Furthermore, low-income households often do not have the financial resources to purchase more energy efficient technologies, such as solar water heaters and house roof ceilings (Winkler, 2006). In South Africa, low-income households are given a free 50 kWh of energy per month by the government to maintain functional households and enhance human well-being (Department of Energy (2012)). Therefore, cultivating energy conservation behaviour in these households can, over the long term, contribute to alleviation of energy poverty and rectify any wasteful behaviour that takes advantage of the government's free energy policy. In fact, apart from South Africa (Winkler, 2006; Department of Energy (2012)), the importance of addressing energy efficiency in low-income households has already been recognised in Ireland (Heffner and Campbell, 2011), the USA (Bird and Hernández, 2012; Hernández, 2013) and Australia (Department of Industry, Innovation and Science, 2015).

In addressing environmental targets, reducing household energy consumption has always been an important component of energy conservation strategies. This is because household consumption can account for a considerable proportion of the electricity consumed (Steg, 2008; He and Kua, 2013) and significantly contribute to greenhouse emissions. In South Africa, households consume nearly 20% of the country's total net energy use, a proportion comparable to that of most OECD countries (Steg, 2008). Thus, from both environmental and economic standpoints, promoting household energy conservation through behavioural interventions can be a lever by which South Africa's energy sustainability can be increased.

However, several studies have shown that the effectiveness of household intervention strategies is complex and is determined by a suite of personal and situational factors (Karp, 1996; Steg, 2008; He and Kua, 2013). Yet, to the best of our knowledge there is still a dearth of detailed studies (and subsequently a lack of empirical evidence) on what and how intervention strategies might influence household energy consumption in South Africa (Winkler, 2006), with a few notable exceptions (for example, Davis and Durbach, 2010). Furthermore, there is limited understanding on the underlying determinants of behaviour, such as personal values and situational factors. This study is an attempt to fill this gap using data gathered from an energy conservation intervention programme among low-income households in a medium-sized town, Grahamstown, in South Africa. The aim of this research was to explore the potential for and effectiveness of interventions in reducing household energy consumption in Grahamstown, South Africa. In this study, "energy" refers to electricity.

2. Literature review on interventions for behavioural change in energy users

There are different studies on behavioural models that describe how energy consumption behaviour of users can be changed. Two of the most applied models are the Motivation-Opportunity-Ability model and the Value-Belief-Norm model. According to the Motivation-Opportunity-Ability model (Olander and Thøgersen, 1995; Steg, 2008), behavioural change occurs only when the following three factors are present – motivation, opportunity and ability. First, in the absence of motivation, households may be aware of environmental impacts of high energy use but may not engage in pro-environmental behaviour (Steg, 2008). Studies show that energy conservation policies and programmes based on normative values are more robust and sustainable than those based on economic imperatives, because people may still engage in pro-environmental behaviour even if it is costly and not profitable to do so (Steg et al., 2014). People are likely to buy into energy

reduction policies if they care for the environment, are aware of environmental costs of high energy use and perhaps most importantly, feel morally responsible to reduce energy use (Steg, 2008; Steg et al., 2014). Second, opportunity or service availability (or lack thereof) may facilitate or constrain pro-environmental behaviour. For example, people may have the motivation to save energy but will not act if there is no support infrastructure to do so. He and Kua (2013) argued that service availability must be high enough to trigger behaviour changes that promote pro-environmental actions. Third, people's engagement in energy-saving behaviour may be influenced by their ability. For example, it may be difficult for people to change their behaviour if they have to buy expensive energy-saving technology as part of the energy-saving programmes, or if alternative energy-saving options are not available or feasible.

Interestingly, motivation is often defined in terms of beliefs, attitudes, intention and social norms, which are all related to the Value-Belief-Norm model (Stern, 2000); this model is in turn built on the Theory of Planned Action. What influences attitudes and behaviour? Studies on social and environmental psychology underscore the importance of personal values and situational factors in influencing peoples' attitudes and behaviour (Barr, 2007; He and Kua, 2013; Steg et al., 2014). Value factors are defined by Schwartz (1994: 21) as "a desirable trans-situational goal varying in importance that serves as a guiding principle in the life of a person or other social entity". Personal values such as comfort, status and effort often determine attitudes and behavioural choices that are made by an individual and can help determine the likelihood that a person is willing to participate in pro-environmental actions (Kua and Ashford, 2004). Personal values that are found to have a positive influence on pro-environmental behaviour promote an openness to change (Karp, 1996). It has also been observed that individuals who embrace environmental quality values are more likely to initiate environmental action (He and Kua, 2013). Studies such as those by Karp (1996), Cialdini (2003) and Fredericks et al. (2015) indicate that normatively crafted programmes are more effective in promoting wider adoption of pro-environmental behaviour than those that are not drawn from the social attributes of the local communities. However, while there is a relationship between attitudes and practices, Heberlein (2012) warns that factors and settings beyond the control of individuals, that is, situational factors, may have more of an influence on what people do than personal beliefs and values, which are commonly considered as the drivers of attitudes.

Situational factors define a given personal situation and consider the different contexts in which a person resides and makes decisions (Barr, 2007). There are different situational factors, including socio-demographic factors such as gender, education level, income level and age and general awareness about environmental consequences of given actions. In general, female, highly educated and high-income earning individuals are pro-environmental (Barr, 2007). Low-income earners often have more concern for meeting their basic needs than for the environment (Anderson et al., 2013). However, these results may not apply in all situations because concern for the environment may not always translate into action. Similarly, it is argued that increased awareness of environmental problems arising from household energy use may promote pro-environmental behaviour, though this does not always translate into pro-environmental actions (Bartiaux, 2007; Desmedt et al., 2013). People with a high level of environmental awareness and concern are likely to exhibit environmentally-friendly behaviour, perhaps because they know and are informed about the consequences of their actions (Barr, 2007). Intervention policies that aim to educate users on long term energy conservation tips are more effective when accompanied by the provision of

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