Renewable and Sustainable Energy Reviews 79 (2017) 1380–1391

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

# Understanding household energy use, decision making and behaviour in Guinea-Conakry by applying behavioural economics

N'Famory Camara[a,*], Deyi Xu[c], Emmanuel Binyet[b]

[a] China University of Geosciences, Department of Economics/Management Science and Engineering
[b] National Tsing Hua University, Department of Power Mechanical Engineering, Taiwan
[c] China university of Geosciences, Department of Statistics

ARTICLE INFO

*Keywords:*
Behavioural economics
Guinea-Conakry
Household energy use
Energy conservation
Psychology
Behaviour change

ABSTRACT

For decades, generalized frauds have left the electrical sector of Guinea with an entirely defective financial scheme. As a developing nation, Guinea's electricity consumption has been relatively low for a long time, although it has been increasing recently due to increasing power generation. The growth in power capacity is due to the construction of two new dams: Kaleta dam (240 MW), which is already operational, and Souapiti dam (550 MW), which is still under construction. Taking into account that the country has so far been without electricity, there is a need to assess and predict consumer behaviour before the full completion of these projects. The aim of this study is to make the household and community reactions to public policy interventions less surprising. However, even sufficient knowledge of how to conserve energy and a stated desire to do so, many consumers still fail to take perceptible measures to increase energy efficiency and conservation. Why is this so? By focusing on crucial insights from behavioural economics and psychology, we highlight the incentive factors, the basic cognitive biases and the psychological phenomena that cause this disconnect. Understanding these factors can help us to design sustainable energy use among consumers in Guinea-Conakry.

## 1. Introduction

Concerns over the state of the natural environment have brought considerable attention to resource conservation at the worldwide, domestic, social, industrial and personal levels [1]. Consumers also appear to be knowledgeable about the worthiness of the call for sustainable energy uses, especially amid growing public concerns over greenhouse gas emissions and climate change [2]. Consumer behaviour is complicated and rarely follows traditional economic theories of decision making. When selecting which products to buy or what services to choose, people often believe that they are making smart decisions and behaving in ways that are rational and in line with their merits and purposes.

The Republic of Guinea is a West African country. Known as French Guinea in the past, today it is called Guinea-Conakry to differentiate it from its neighbour Guinea-Bissau as well as Papua New Guinea and the Republic of Equatorial Guinea. In 2006, the Republic of Guinea had an installed[1] energy capacity of approximately 239 MW for an estimated population of 11,948,726 inhabitants in 2013 [3]. On June 12, 1992, Guinea signed the United Nations Framework Convention on Climate Change (UNFCCC) that was ratified on May 7, 1993 [4]. The Convention's aim is to encourage all member countries to establish a GHG emissions inventory by source and GHG removals by sink, to propose mitigation measures, to identify socio-economic sectors that are vulnerable to climate change and to develop adequate strategies to address this phenomenon. For Guinea, taking part in the UNFCCC convention was a step forward, but it would be useless if the government of Guinea did not follow its requirements appropriately. Thus, to fulfil these requirements, the Government of Guinea and China International Water & Electric Corporation (CWE) signed a contract in 2011 to construct the hydroelectric project of Kaleta dam. Souapiti dam is the second project undertaken by CWE in Guinea, following the completion of Kaleta dam in July 2015. Kaleta dam has tripled power generation to Guinea and has spurred efforts to expand access to the grid to 12 million citizens. With the completion of Souapiti dam in 2020, Guinea would be able to supply electricity to

* Corresponding author.
*E-mail addresses:* nfamoryc@yahoo.fr (N. Camara), emmanuelbinyet@hotmail.com (E. Binyet), xdy@cug.edu.cn (D. Xu).

[1] The installed electricity production capacity equals approximately 239MW and is provided by 9 hydro plants and 18 thermal power plants. The production capacity of the 9 hydro plants is 127MW. Guinea has a significantly low rate of access to electricity, estimated to be less than 17% for the entire population [160,161]. With the completion of Kaleta dam in 2015 and Souapiti dam in 2020, the installed capacity is estimated to be 479MW (239MW+240MW) and 1029MW (479MW+550MW), respectively. Following the completion of Kaleta in 2015 and Souapiti in 2020, the access rate is estimated to be 34.07% and 73.19%, respectively. As a result, the installed capacity required for 100% access is estimated to be 1405.88MW.

http://dx.doi.org/10.1016/j.rser.2017.03.128
Received 26 August 2016; Received in revised form 10 February 2017; Accepted 28 March 2017

its inhabitants and sell electricity to its neighbour nations [5]. Therefore, the Republic of Guinea is under transition as development and urbanization increases household earnings and modern fuel access [6]. Therefore, the construction of these two dams is a step forward for Guinea but is not the best possible step over the past 23 years. According to statistics, Guinea has only built 2 hydroelectric dams (Samankou dam, 0.24 MW, built in 1996 and Garafiri dam, 75 MW, built in 1999) since UNFCCC 1992 despite its population increasing by 77% [3] from 1992 to 2013. This situation has surely contributed to an increase in biomass and hydrocarbon consumptions and reducing the existing supply of these fuels. From the above, it is perhaps unsurprising that in 2009, Guinea's energy consumption per capita was less than half a ton of oil equivalent (TOE): 80% from biomass, 18% from hydrocarbons and only 2% from electricity [7]. According to the results of investigation reports from households, wood and charcoal are the main sources of energy used for cooking in Guinea. The percentage of households using these two sources for cooking were 74.6% and 23.9% in 2012 compared to 78.2% and 19.5% in 2007, respectively. This has given rise to natural resources exploitation and abuse. Wood energy dependence in developing countries has been considered a threat to environmental and development goals for more than 30 years [8]. At first, the "fuel wood crisis" was attributed to the noticeable gap between declining third world wood supply and the rising energy demands of increasing poor populations [9]. Through later re-evaluation, these claims were proven false [10], and identified agricultural expansion was identified as the main cause of deforestation [6]. In Guinea, bushfires are one of the main factors of deforestation; these fires can be of natural origin (e.g., lightning), but they usually have anthropogenic causes: hunting, agriculture, livestock and beekeeping [11,12]. In fact, deforestation can lead to two socio-economic issues. First, low income urbanites may encounter difficulties meeting their energy demands due to the fuel wood gathering border moving farther away from residential areas [13].

Second, the urban mining of fuel wood in nearby zones [14] contests with rural bioenergy needs [14,15] and diminishes rural subsistence by participating to deforestation [16], desertification [17] and other irrevocable ecological changes [18]. According to Foley, fuel wood issues must be alleviated by demand mitigation and eventually by replacement with additional fuels [19,20]. Therefore, enhancing access to electricity in Guinea would lower the impact on the environment by reducing deforestation due to switching firewood for electricity [21]. In addition, particulate matter in smoke has major health impacts [22,23]. From the above observations, the failure of the government of Guinea to follow the UNFCC requirements has contributed to an overall environmental and social degradation (e.g., deforestation, increased biomass harvesting, health problems, lack of electricity). Further evidence to support this is the failure to address public concerns about the safety of supply or the affordability of climate change interventions that may endanger the fulfilment of motivated carbon emissions reduction goals [24]. Therefore, technical enhancements and public awareness are not sufficient to solve environmental problems; instead, there is a necessity for a radical change in lifestyle [25]. However, daily life in Guinea illustrates a different situation. People often diverge from the "rational choice" model of human behaviour, in which one dispassionately consider the costs and benefits of all options before choosing the optimal course of action [2]. For instance, as stated above, people may be aware of "green" principles and values and the use of renewable resource, but this knowledge is not translated into pro-environmental choices when utilizing services that harm the environment. Nonetheless, since the completion of Kaleta dam in July 2015, many people in Guinea still rely heavily on non-renewable resources while taking actions they may themselves acknowledge as wasteful. That is, what people say and what they do are often in opposition.

Therefore, to understand such complexities, we illuminate many domains of human behaviour, such as the knowledge-action gap [26,27], the value-action gap [28,29], the attitude-action gap [30] and the intention-action gap [31,32]. One domain of human behaviour where this disjuncture is evident is residential energy use [33,34]. The government of Guinea owns over 1000 buildings; the energy bills of these buildings are quite high due to the following factors: poor user habits, lack of thermal regulation of the buildings, lack of energy labelling, and lack of standard equipment selection.

Therefore, it perhaps unsurprising that the government and general media often fail to achieve the sustainable behaviour change that is planned, perhaps because they promote pro-environmental knowledge and behaviour by merely scattering information [35,36]. However, interventions to alter daily behaviours often aim to change people's viewpoints. Effective habit change interventions require disrupting the environmental components that mechanically cue habit performance [37]. Interrupting the environmental cues that start and retain habit performance allow habits to change [38]. Most people say that they are worried about climate change and realize the significance of conserving energy; however, this worry is translated into taking ongoing, convenient steps to lower household energy consumption. This is because they are pursuing material interests and extrinsic rewards; therefore, their behaviour does not generally display their environmental worries or commitments. Even though energy conservation measures are demonstrably cost-effective (e.g., insulation, low carbon, technology), many people in Guinea remain unwilling to bring these things into their lives. In fact, promoting pro-social behaviour (e.g., volunteering, civic duty, and charitable donations) by providing extrinsic rewards and financial incentives can sometimes reduce the desired behaviour [39,40]. Energy conservation behaviours are supported if they are internalized [41], and internalized behaviours are generally self-promoted and therefore self-determined [42]. This is important because non-prompted behaviour can reduce prompt costs [1]. In this manner, in Guinea, the generalized fraud suffered by the operator of the electric sector, which was left with an entirely defective financial scheme, blocked any possibility of improving production equipment and distribution and thus compromised any chance of improving the quality of services. These frauds are mostly due to illicit linking to existing networks, trafficking with metering equipment or refusing to pay for service [43]. Depending on the country, the rate of these frauds can be over 50% of output, which raises questions about the viability of a Public-Private Partnership (PPP) project and restricts the development of infrastructure for servicing under-served areas and enhancing existing consumers' services; ultimately, the costs and burdens of these frauds are carried by paying customers through higher tariffs [43]. In 1999, the Chief Minister of the Indian state of Andhra Pradesh stated that it would not be possible to privatize the nation's power enterprises without reducing power theft. From the above, we can see that the failure of the government of Guinea to follow the UNFCCC convention and consumers' attitudes have contributed to a mass environmental destruction. According to Leach and Mearns, with the new power capacity from Kaleta and Souapiti dams, the Republic of Guinea will begin to transition as economic growth equals modern fuel uptake [6]. To ensure sustainable energy use in Guinea, it is necessary to clarify the above complexities. Because daily behaviours are persistent, they have major impacts on social, medical, and economic outcomes at both consumer and society levels. There are few or no studies about Guinea's household energy use, decision making and behaviour. Thus, due to the severe documentation shortage in Guinea, many assumptions were made.

This research focuses on household energy use and decision making in Guinea. By applying behavioural economics, we highlight the basic cognitive biases, the incentive factors, and the psychological phenomena. Understanding these factors will help to design more cost-effective and mass-scalable behavioural outcomes to encourage sustainable energy use among consumers in Guinea. This paper is organized into four sections: In Section 2, we apply behavioural and psychological economics to explain, predict and change consumer behaviour in