Available online at www.sciencedirect.com

ScienceDirect

Energy Procedia 93 (2016) 46 – 52

Energy Procedia

Africa-EU Renewable Energy Research and Innovation Symposium, RERIS 2016, 8-10 March 2016, Tlemcen, Algeria

Sustainable energization of rural areas of developing countries – a comprehensive planning approach

Jerome Ndam Mungwe[a,b]*, Leonardo Bandiera[b], Dario Accorona[b], Emanuela Colombo[b]

[a]*School of Engineering, Catholic University of Cameroon, Bamenda, P.O. Box 782, Cameroon*
[b]*UNESCO Chair in Energy for Sustainable Development, Department of Energy Politecnico di Milano, Via Lambruschini 4, Milano, 20156, Italy*

Abstract

Access to modern energy services in developing countries (DC) is a double-faced challenge. About 1.3billion people do not have access to electricity; 2.6 billion rely on traditional use of biomass for cooking. Solutions to this energy challenge can neither be through isolated promotion of individual technologies nor fuel switching alone. A "system approach" towards a more comprehensive energy access strategy is required. Such access strategy would comprise of the supply of alternative energy carriers and planning of complete energy solutions via a more comprehensive and sustainable Rural Energy Planning (REP) i.e. Sustainable Energization (SE). Existing procedures to SE do not account for the existing energy balance and have not been demonstrated in the context of rural areas. The study aimed to propose and consolidate a more comprehensive REP procedure for SE of rural areas of DC. A seven-step procedure is proposed and its relevance and validity demonstrated through a field case study. The proposed procedure takes into account the existing energy balance and integrates energy drivers in the energy services supply network. Application of the procedure in a rural context showed a great improvement in the quantity, quality, and variety of accessible and affordable energy services for a more sustainable development of rural areas.

Peer-review under responsibility of the organizing committee of RERIS 2016

Keywords: Biomass; modern energy access; energy planning; sustainability; sustainable energization.

* Corresponding author. Tel.: +39 022 399 3820, +237 651 047 046, +237 664 767 835; fax: +39 02 2399 3913, +237 3307 2942.
E-mail address: mungwe.jerome@polimi.it, jnmungwe@catuc.org

Peer-review under responsibility of the organizing committee of RERIS 2016
doi:10.1016/j.egypro.2016.07.148

1. Introduction

1.1. Scope, problem and objective

The challenge towards the achievement of universal access to modern energy services among other interlinked global energy targets by 2030 is huge. The situation may be more challenging in Sub Sahara Africa (SSA), where more than 650 million people, mostly in rural areas will continue to use traditional biomass for cooking in an inefficient and hazardous manner till 2040 [1]. Improved Biomass Stoves are being promoted as a practical way forward to a more efficient use of solid fuels [1,2]. However, debates still persist as to the efficiencies of these cooking devices. A shift to alternative fuels away from traditional use of biomass is advocated [3].

Within the above context, the issues highlighted can neither be resolved through isolated promotion of individual technologies nor fuel switching alone, but through a "system approach" to a more comprehensive energy access strategy. This will entail the supply of alternative energy carriers and planning of complete energy solutions through a more comprehensive and sustainable Rural Energy Planning (REP).

The objective of this paper is to propose and consolidate a more comprehensive REP procedure for the sustainable energization of rural areas.

1.2. Brief review of the literature

Improving energy access in rural areas of DC can be approached by re-examining the strategies for REP and the concept of energization. Existing approaches to REP include: electrification, integrated energy centres, unplanned energy supply systems, e.g. local firewood markets, isolated energy carrier/technology programs e.g. biogas programs, improved cook stoves, [4–6]. These strategies are often implemented in isolation, hence, have not met the objectives of improving energy access in DC. To improve the situation necessitates a holistic energy system and planning approach. REP models are based on the six-phases Advanced Local Energy Planning (ALEP) process developed by the IEA [7]. The concept of energisation captures very well the issue of energy access for poverty alleviation and sustainable development. The concept has been defined in several ways [6,8,9] however, it has been updated to the theme of Sustainable Energisation (SE) [6]. Within the framework of SE, some gaps have been observed in studies that analysed rural energy systems within the ALEP framework [4,5]. These gaps include: the planning does not consider the sustainability of the energy system, there is a lack of a systematic energy consumption database required for modelling, the studies rarely quantify energy consumption to levels required for realistic modelling, and most models tend to marginalise the multidimensional issues of specific energy supply objectives. These drawbacks are due to the non-integration of SE in the planning process. Nissing et al [4] proposed a six-step procedure in the main study phase of the ALEP process that integrates SE in the REP process. Their procedure does not take into account the energy balance in the existing energy supply system and has been demonstrated only as a theoretical economic model for an urban developmental context.

2. Methods

The objectives of the study were achieved through desktop study of REP process and subsequent formulation of an innovative procedure. The proposed procedure was consolidated through a field study. The study area was Cameroon Protestant College (CPC) Bali located in the rural area of North West of Cameroon. CPC is made up of the following services and facilities: Public Administration, Education, Healthcare, Craftsmanship, dormitories and households, a church, 1179 inhabitants. Considering its organisation and composition, the area was considered a "*micro village*". Various methods and tools were used at each stage of the planning procedure. In particular, in accounting for the existing energy situation of the study area, participant's observations, focus group discussions, direct measurements and survey questionnaires were used to account for the Primary Energy Supply (PES) and Final Energy Consumption (FC) of the study area. For the assessment of local renewable resources, the focus was on biomass for biogas production, hydropower, wind and solar energy. The methods and tools used in the assessment of the locally available renewable energy resources are describe herein below.