Renewable and Sustainable Energy Reviews 69 (2017) 313–323

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

The SWOT model's utility in evaluating energy technology: Illustrative application of a modified version to assess the sawdust cookstove's sustainability in Sub-Saharan Africa

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ARTICLE INFO

Keywords:
Biomass cookstove
Cooking devices
Cookstove
Improved cookstoves
Renewable energy
Sawdust cookstove
Sub-Saharan Africa
Sustainable development
SWOT

ABSTRACT

This paper tackles two main tasks. First, it reviews the use of the Strengths-Weaknesses-Opportunities-Threats (SWOT) model in the energy sector. The review sheds light on the utility of the SWOT model in this sector. It reveals that the model, which is borrowed from the business world, has been employed only rarely and with little modification in the energy sector. Second, it develops and proposes a modified version of the model for use in assessing energy technologies in developing regions. The modified version contains two main variants, the one, qualitative and the other, quantitative. The qualitative variant is successfully employed here for illustrative purposes, to assess the sustainability of the sawdust cookstove as a cooking device in Sub-Saharan Africa (SSA). The quantitative variant requires data that can be elicited through questionnaires and/or interview schedules administered to energy sector stakeholders, policymakers and/or energy experts. Both variants have potential use for technology developers, researchers and policymakers in the energy policy field in SSA in particular and developing regions in general.

1. Introduction

The rich insights of the Strength-Weaknesses-Opportunities-Threats (SWOT) model have seldom been summoned to evaluate the sustainability of energy technologies. The paucity of SWOT's use in efforts to evaluate energy technologies is probably due to the fact that the model was initially intended for business strategic planning. Yet, the utility of this model is not limited to such planning. Rather, it can be extended to other milieus. Subsequent to its introduction in the business world by researchers at the Stanford Research Institute, USA, in the 1960s [1], it has been adopted in regional development and municipal planning. Efforts to utilize SWOT in the energy sector are of recent vintage but have been steadily growing. In every case, the model has been employed verbatim to evaluate organizations in this sector see e.g., [2–4]. Efforts in this regard are deficient in two major respects. First, they have made no attempt to modify the model to suit the specific conditions of developing countries. Yet, it is obvious that these conditions differ markedly from those for which the model was originally designed. Second, hardly any efforts have gone into employing the model to assess the effectiveness and efficiency of specific energy technologies. Whatever little has been done in this respect is limited to the developed world see e.g., [5].

My main objective in this study is to address this deficiency. I accomplish this objective by modifying the classical SWOT model for use in assessing the sustainability of energy technologies in the developing world. I begin in the next section by developing a conceptual framework and reviewing the literature on the use of the classical SWOT model in the energy sector. Then, I modify the model at two levels. The first is intended to render it suitable for use in evaluating technologies as opposed to organizations, its originally intended target. The second is to facilitate its application in the unique context of Sub-Saharan Africa (SSA). Following this, I discuss the potential utility and function of the modified model in research and policy making. In a subsequent section, I employ the model to assess the sustainability of the sawdust cookstove as a cooking device in SSA. I end the paper with some concluding remarks. The paper's main contribution to the extant literature on renewable technology can be appreciated in terms of its substance, thematic orientation and geographic focus. Its substance, evaluation of the sawdust cookstove, promises to provide grist for the mills of renewable energy researchers, practitioners and policy makers. Its thematic orientation, namely the use of SWOT in the energy sector, adds to the scanty literature on the utility of a viable but seldom-employed evaluative tool. Finally, its geographic focus, sub-Saharan Africa, is in and of itself a novelty because of the dearth of energy technology research concentrating on the region.

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http://dx.doi.org/10.1016/j.rser.2016.11.049
Received 13 October 2015; Received in revised form 6 July 2016; Accepted 4 November 2016
1364-0321/ Published by Elsevier Ltd.

2. Literature and conceptual framework

The strengths, weaknesses, opportunities and threats (SWOT) model was originally developed for business organizational decision making, product evaluation and strategic planning. Also known as the SWOT matrix, the model was developed by a research team at the Stanford Research Institute (SRI) in the 1960s and 1970s [6]. Led by Robert Stewart, the team included Marion Dosher, Otis Benepe, Birger Lie and Albert S. Humphrey. The specific research project that gave birth to this model was funded by the Fortune 500 companies. The companies had become disenchanted with the results of corporate or long range planning. Consequently, they needed to develop more innovative planning methods, particularly those that held promise for managing change.

As part of their efforts to address this need, the researchers developed and administered a 250-item questionnaire to more than 5,000 executives in some 1,100 major organizations between 1960 and 1969 [7]. The researchers sought to determine the 'positives' and 'negatives' about any given operation; as well as the 'positives' and 'negatives' of present and future operations. What was considered positive in the present, they classified as 'Satisfactory' and what was viewed as 'positive' in the future, they labeled it an 'Opportunity'. What was perceived as 'negative' for the present, they labeled it a 'Fault' and what they saw as a 'negative' for the future, they classified it as a 'Threat.' From this exercise, they generated the acronym, S-O-F-T. According to a paper he wrote in 2005, Humphrey stated without further explanation that this acronym was later changed to SWOT at Harvard and MIT [8]. Both acronyms are useful for the purpose of assessing new technologies in the sustainable energy industry, although for now, further elaboration of SWOT is warranted. In the conventional application of SWOT, strengths and weaknesses are regarded as internal, while opportunities and threats are seen as external, to the organization [9].

The SWOT matrix as shown in Fig. 1, contains four cells labeled, S-W-O-T. The columns relate to the nature of the impact—negative or positive—that a factor has on the organization. On the one hand, cells S and O fall under the column labeled 'Helpful,' indicating that an organization's strengths and opportunities help it achieve its objectives.

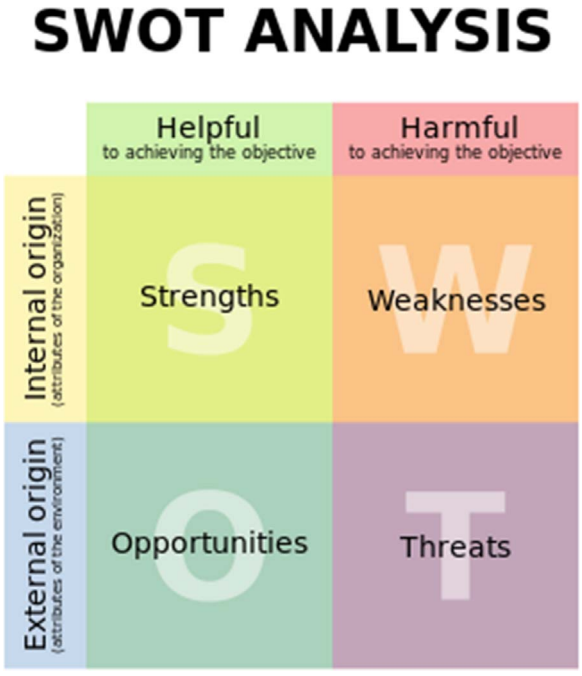

Fig. 1. The SWOT Matrix.
Source: Wikimedia Commons, the free media repository (Accessed, Sept. 26, 2015). https://commons.wikimedia.org/wiki/File:SWOT_en.svg

On the other hand, the cells W and T, fall under the column labeled 'Harmful' suggesting that an organization's weaknesses and threats are harmful to the organization. The rows capture the origin of real or potential factors affecting an organization. Thus, as the figure shows, factors constituting an organization's strengths or weaknesses are internal to the organization. In other words, these factors originate from within the organization. Conversely, opportunities and threats, under the second row are located outside of the organization.

Since its introduction, the SWOT model has been used in different business and non-business settings alike. Its use in the energy sector is of fairly recent vintage. Here, its application has mainly been for five main purposes, including the assessment of:

- energy corporations or companies;
- national energy networks;
- regional energy delivery systems;
- energy technologies; and
- energy sector products.

None of these works has focused on a developing, let alone an African, country. Consequently, the ensuing review will draw on examples exclusively from the developed world.

2.1. Energy corporations or companies

Worth noting in the fledgling literature on the use of SWOT in the energy sector is a study of the US-based General Electric Corporation (GE) [10]. The study employed the classic SWOT model and focused on an equally classic target, namely a business organization. Rather than addressed to an academic audience, the study was undertaken for marketing purposes. Nevertheless, it is informative as it promotes knowledge on how to go about assessing an organization in the energy sector. Among its strengths as revealed by the study's results, is the fact that the corporation was designated by Forbes Magazine as the largest US company in 2009. This suggests that size matters for an energy corporation just as it does for corporations in other sectors. Listed among its weaknesses is the fact that some of the corporation's activities contributed to air and water pollution. The study listed one opportunity, namely research and development but no threat.

2.2. National energy networks

A few works have employed the SWOT model to assess the energy sector at the national level [11–13]. By so doing, works in this category have broadened the scope of SWOT analysis to encompass an entire sector as opposed to a specific agency in that sector. However, the national as opposed to organizational focus is the only dimension on which studies in this category differ from classic SWOT analyses. The following classic definition of SWOT analysis adopted by Liu and others constitutes a testament to my assertion.

> SWOT analysis is a planning tool which aims to identify the strengths and weakness of an organization and the opportunities and threats in the environment [14, p. 1381].

Yet, the national focus of these studies is noteworthy for the purpose of the present discussion. Further analysis of the works of Markovska and others [15] and Fertel and others both of which have a national focus is in order. Markovska and others [17] surveyed stakeholders in the energy policy field of Macedonia. They employed the SWOT model to elicit information from energy sector stakeholders on what they considered to be the strengths, weaknesses, opportunities and threats of the country's energy sector. Based on the results, the progressive adoption of E.U. standards in energy policy, according to the stakeholders, constituted a major 'strength.' In other words, this was viewed as one of the country's greatest achievements in the energy policy field. At the same time, the stakeholders considered the country's