Investigation of Sustainable Energy Policy: Nairobi Case Study

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Abstract. A plan for actively achieving green energy obligation is a strategic tool for policies that point forward the diminution of the fossil fuel consumption and greenhouse gas (GHG) in conformity with the Paris environment-friendly accords (COP21) and updates of other eco-system agreements. To achieve the concrete implementation of the sustainable energy strategy (SES) and to accomplish its objectives, an investigation is a critical factor. SES investigation has to consider both the advancement of each particular action and its wide-ranging green effect, which necessitates multiple levels of improvement. In this study, a consolidated eco strategy for evaluating, monitoring and handling the SES via investigation and execution process is established. The city of Nairobi was used as one of the geographical positions to test the effectiveness of this approach and to investigate its robust and weak points. Specifically, benefit-cost analysis, reliability, peer review and general level of participation were renowned as vital tools for attaining a functional SES investigation and for then drafting successful energy guidelines. Some suggestions were put forward to highlight the research and execution methods and to draw a road map of how SES can be strategically placed into practice.

1. Introduction

For many years ago, the SES has turned out to be a central tool for establishing regional energy policies and the initiative program covered all 17 municipalities in Nairobi. All partners have subsequently believed in a progressive role to reach the Kyoto Protocol goals and, now of the Paris climate change accord. The positive achievements of this scheme and its continuing advancement called National Climate Change Action Plan (NCCAP) do not take away the difficult coupled with SES execution. The SES works as a vital tool to be improved and performed with maximum efficiency based on gained results of compliance with the GHG reduction strategy. In agreement with the methodological perspective, the SES builds on the outcome of the inventory on gas emissions that quantify the consumed energy and emitted CO_2 of the urban area and categorizes various actions to be taken in priority locations. The SES can achieve its goals through proper planning, execution, and monitoring with coordinated efforts at the municipal level bringing together public institutions, the private sector, and local communities. Throughout the implementation, the SES has to deal with changing needs and confront evolving situations. Industrial expansion, public policies, economic position and regulatory mechanism continually changes, hence demanding an equivalent evolution of the SES [1]

Therefore, the monitoring tasks are a vital opportunity to investigate the implementation level and assess the planning process. According to **Kenya** Vision 2030, throughout the SES application, the local counties try to enhance the quality of the environment through a continuous improvement process. This way of viewing things is described as investigation and monitoring (I & M) that,

adequately represents the ideal process[2, 3]. A smooth implementation of the SES solidly depends on this repetition process of continually checking and improving environmental quality. This process is not easy; various researchers have shown that SES I& M necessitates much attention because of the important challenges that frequently hold back an efficient execution of this process [4].
In this case, starting with the viewpoints suggested in the NCCRS about monitoring, assessment, and case study know-how skills, the researchers answer a few major questions. Preferred actions should be able to achieve an anticipated GHG emission diminution, but the pathway of their execution and updates do not suffice. The first point was to know if there was any other step forward to test whether the actions taken are adequate. The second aspect was to know how monitoring can develop into an adequate tool to contribute to the overall goal. This study determines the strategic plan for SES follow-up and uses the case of Nairobi SES for reflections on the ground experience. Subsequently, after discussing the questions mentioned earlier, some recommendations were put forward.

2. Research background

The implementation of an SES has to take into considerations the needs of updating and changing, the know-how skills and related political will; simultaneously, the economic and regulatory mechanism and the counties' feedback need to be considered too. Therefore, this paper has developed valuable tools for the execution of actions, with regards to repeated process illustrated in Figure 1.

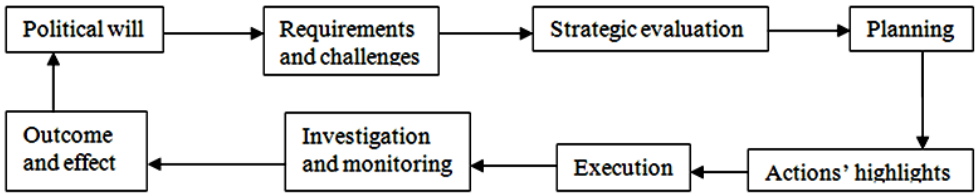


Figure 1. SES monitoring practice loop.

After the submission of the SES, all municipalities and counties were committed to compiling data and producing biennial reports. The first report quantifies the information on efforts to assess, monitor and confirm the implementation and the effect of the SES progress. The second report provides updated data on CO2 emission situation that is compared against NCCRS inventory. This study embraced methodologies based on multiple conflicting criteria, strictly for SES planning stage[5]. A multi-criteria decision analysis (MCDA) helped establish the appropriate combination of energy scheme and techniques for undertaking investments with maximum effectiveness. Nevertheless, they have primarily been used for examining the efficiency of one particular source of energy or technical solution[6].Although monitoring tool shows a positive outcome, it cannot guarantee the accuracy of final results alone by a simple tracking. There must be a need to collect and assess feedbacks from the field to orient decisions in the adequate direction.

2.1. The monitoring of the SES

As a result of the embracing the environment-friendly energy plan and Kyoto agreement on climate change, the Kenyan Government initiated a countrywide climate change response strategy (KNCCRS 2010) and climate change action plan (KNCCAP, 2013). These initiatives aimed at kick-starting the development, the actualization of energy and climate change policies in compliance with global eco-friendly accords [2, 7]. The KNCCRS had objectives of raising awareness and educating people about the reality of climate change in Kenya. The KNCCAP launched on 27th March 2013 and the execution tool it upholds, the SES are established within this agenda and encourage the implementation of Kenya's commitments to the Kyoto Protocol with an independent and intentional contribution of all partners [2]This article has analyzed the techniques presently used to monitor the SES, and possible execution of this course of action was assessed. Therefore, the present method for this issue must be demonstrated, and its strong points and limitations will be drawn to attention. The next section explains an approach, puts in place a benchmark and establishes an environment for a critical analysis

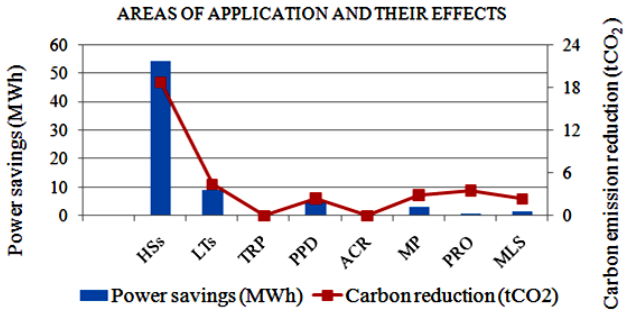
that uncovers much more useful practice. The reporting template in the SES monitoring is divided into three major subsections:

- Course of action to evaluate the SES implications;
- Adjusting finances and providing updates to stakeholders and
- Inventory for GHG emissions.

Monitoring and updating the measuring system in the SES progress comprises four stages:

- Identification of the persons in charge of SES on municipal level;
- Organizing general meetings and setting up relevant timetable;
- Holding sessions of professionals to share expertise and updates
- Examining qualitative study process and exploring quantitative research blueprint in SES evolution

The NCCRS gives a control template for the SES execution in which each measure shows new area to be filled in such as personnel qualifications, expenditures and some challenges compromising the SES performance. The SES monitoring took into considerations the sectors recommended in the NCCRS such as houses (HSs), lights (LTs), transportation (TRP), municipal planning (MP), public procurement (PRO), power production (PPD), air conditioning & refrigeration (ACR) and miscellaneous (MLS).Although it was not technically easy to quantify, the Nairobi city council was committed to investing in untapped green energy resources and purchasing power saving products. On the other hand, the ecosystem monitoring was focusing on power savings and equivalent carbon emission reductions in every area of application in 2015 (see Figure 2).



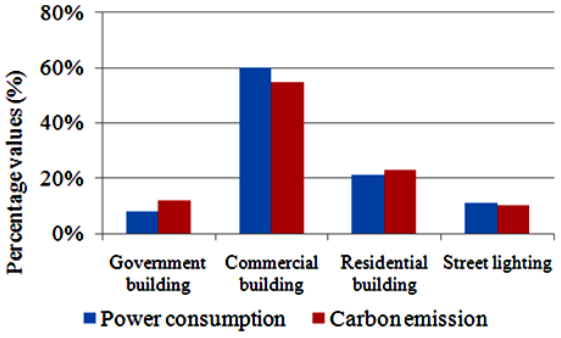


Figure 2. Areas of application & power savings, 2015. **Figure 3.** Power consumption and GHG, 2010.

It is clearly noticed that the amount of reduced carbon emission varied from case to case (see Figure.2), this gives details of fundamental challenges affecting the results. Furthermore, the comparison between intervention action advancement and the equivalent ecosystem improvement provides comprehensive knowledge of the critical challenges. With regards to the progress of SES corrective steps, for some 176 intervention works, some have already started, and others are under development process. Throughout the SES monitoring, critical challenges related to intervention actions are no more valid just because the administration has updated policies or because incredibly complex intervention actions had to be deleted. Figure.3 presents the status of power consumption and GHG emission in 2010.The business buildings consume most of the power generated and subsequently emit a high level of carbon emission, followed by residential building.

The comparison of NCCRS inventory (2010) and SES-GHG inventory (2015) with regards to the type of fuel (see Figure.4) shows a significant improvement with all types of fuel. The liquid gas is leading the trend with a potential reduction in GHG emission going to 31.3%, fossil fuel to 24.3 %, biomass to 18%, natural gas to 14.4 % and electric power to 7.63%.Figure.5 compares CO_2 between the year 2010 and 2015, the reduction of CO_2 amounted to 20.9% in business buildings and 6.9% in public buildings. Although there was an improvement, the SES execution faces some challenges: a) difficulties in retrieving data, b) financial constraints and market dynamicity, c) long process for technological implementation and d) inadequate procedural methods. Also, the cost-benefit evaluation must be used in a simplified manner since the primary objectives are reducing carbon dioxide gas emission. Cost

estimates help the operators update and identify the most beneficial and priority projects. Subsequently, the MCDA techniques seem to be suitable for the SES monitoring advancement since they consider cost as a key criterion[8].

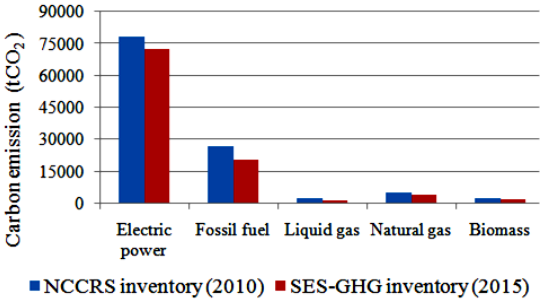


Figure 4. Types of fuel and CO_2.

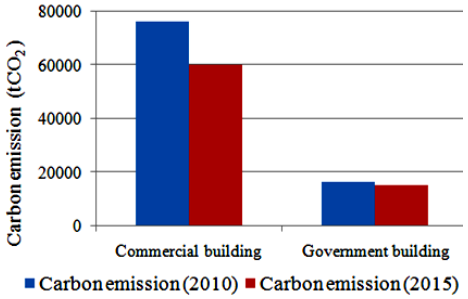


Figure 5. $CO_2$and some areas of application.

2.2. *SES advancement*

The SES monitoring necessitates being regularly updating and informing to the relevant authorities for the examination of the GHG emission reduction and the discussion on qualitative and quantitative advancement. The SES progress report shows in Figure.6 that the vision 2030 climate change target ranges between 50% and 70 % carbon reduction, whereas the for the last seven years the highest carbon reduction level was 33%. And Figure.7 shows the CO2 emission status at the launch in 2010, the current situation in 2017 and the CO2 emission target in 2030 for various areas of application.

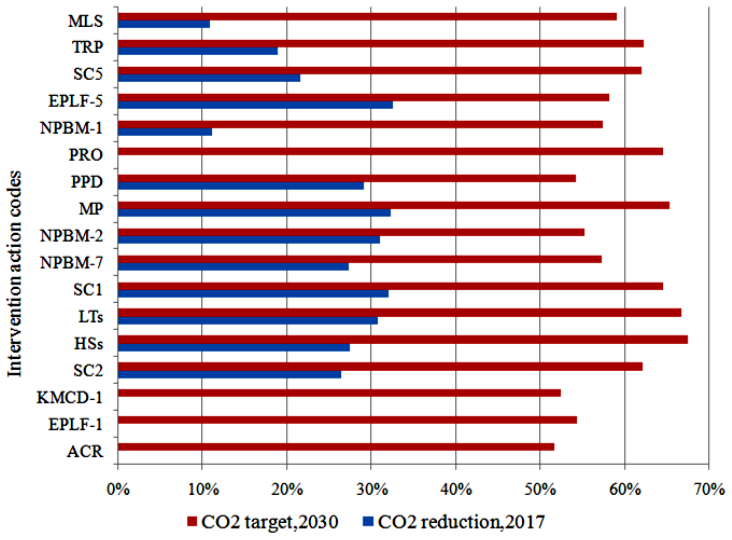


Figure 6. SES advancement report.

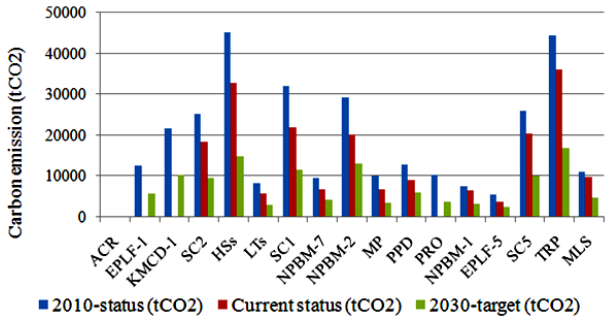


Figure 7. Comparison of CO_2between 2010 & 2030.

3. Conclusion

The SES must be continually updated in content and methodologies for better evaluation progress and policy making. Besides, the SES monitoring should consider the advancement of every action and its global ecological effect since it requires a collective examination and describes an entire process for a long-lasting reduction of GHG emission from different municipalities. This research provides details of those challenges and should serve as a model for other cities, especially in Africa, dealing with climate change issues. The assessment of problems and opportunities facing the city of Nairobi in monitoring should help other cities implement the long-term process and outline a strategy at the beginning of each section of SES, thus smooth the progress of best I & M practices.

The development of the inventory of gas emissions was a crucial part of this monitoring strategy, and it was an occasion to engage communities and create a productive network of collaboration in collecting green energy data. A peer review process was proven to be the useful tool to measure the SES accuracy and reorient actions according to variations of the external factors that can compromise the outcome. There is a need for a mind-set that invests in individual productivity and strengthens the SES monitoring policies in different municipalities. There is an alarming increase of fossil fuel consumption especially in electricity production in Nairobi; therefore, the future study should investigate the efficacy and the ecological impact of diesel powered electrical generating stations.

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