

Increasing Electricity Access in East Africa

Solomon A. Asfaw, PhD

The electricity consumption per capita of most East African countries is very low relative to most other countries in the world. The available service is also marked by unreliable supply, insufficient generation capacity, and high cost. Current power sector development trends and 2030-generation capacity targets still leave the majority of the population in Sub-Saharan countries without electricity access. However, in order to achieve development goals such as reducing poverty, reducing inequality, increasing food security, and increasing health and educational services, expansion of efficient energy services, such as electricity, are expected to play significant role. To raise the electricity access in accordance with foreseen economic growth, the United Nations Secretary-General's Advisory Group on Energy and Climate Change recommends setting a universal electricity access goal by 2030. No clear policy landscape currently exists in East African countries for increasing future electricity access.

To identify possible challenges and different ways of achieving universal access, detailed long-term power system planning research is very important. This planning research should improve upon many of the limitations of the present day planning models used in these regions. Some of these limitations are: (a) dependence on the largely suppressed historical demand as a proper indication of future demand in these countries (b) reliance on centralized generation and direct grid connection as means of electrification (c) emphasis on conventional generating resource types in power system planning studies (d) low consideration to the impact of national and regional electricity access policy (e) reliance on low spatial and temporal resolution data.

I am interested in constructing a high spatial and temporal resolution power system planning model for the 10 East African countries that are working to create a regional power grid under the Eastern African Power Pool (EAPP). My proposed research is being carried out in Professor Daniel Kammen's laboratory at the University of California at Berkeley. It has two stages:

a) Building a template model

A template model will be built by combining the existing EAPP master plan and the SWITCH model power system capacity expansion-planning model. SWITCH is a high temporal and spatial resolution model that is being developed in Professor Kammen's laboratory. In the first stage, the EAPP master plan will serve as a source of data and validation for the first template. For this purpose, I intend to initially keep the load forecast and many other major assumptions from the master plan. At the same time, in order to assess the reliability of the master plan and identify remedies if needed, I will examine the impact of improved temporal and spatial resolution, and include other sensitivities to model assumptions.

b) Scenarios for Expanding access

In the second stage, I will explore different electrification target scenarios and possible ways of meeting these targets. The value of different centralized and distributed electrification options will be weighed based on Local population density, distance from power transmission infrastructure and local demand forecasts. Suitable user based demand profile forecast is expected to be developed through close collaborations with local operators. The fleet of generators between which the optimization model can choose will also be updated to meet the expected demand increase and mix of generator requirements for various electrification methods. This fleet will certainly include intermittent generators such as wind and solar, small hydroelectric generators, and conventional generation options. The quality of such a study depends, among other things, on the quality of the database. I intend to work closely with the governments of each countries, and hire national agencies (if necessary), to produce some of the required data. First, electrification scenarios in the Kenya - Ethiopia corridor will be explored. Later the study will be expanded to other EAPP countries.

During my Ph.D. study at Ben-Gurion University of the Negev, Israel, I examined possible ways of grid restructuring for high penetration of intermittent renewable energy with and without storage. Recently, I have been working with the SWITCH team at Professor Kammen's lab. Professor Kammen is a leading national and international energy policy analyst, who has been working as World Bank Group's Chief Technical Specialist

for Renewable Energy and Energy Efficiency. His work emphasizes both technological and economic considerations in energy policy analysis. By working under his supervision, I hope to help in shaping the policy landscape regarding electricity access.