

Master thesis proposal: Socio-economic benefits of energy storage in solar PV mini-grids in east Africa

Around one billion people lack access to reliable and affordable electricity. These people mostly live in sub-Saharan Africa, in rural and inaccessible areas. Extending the current large-scale national grids to these areas can be very costly. In addition, the reliability of electricity in many sub-Saharan African countries is very low. In order to facilitate economic growth, provide social security and improved quality of life, reliable and affordable electricity is needed. The reduction of the cost of solar PV cells, and more recently battery energy storage, has already had significant positive impacts on electricity access in sub-Saharan Africa. With the lower costs, solar PV and battery combinations can provide cost-effective and renewable electricity to rural communities.

Households generally consume electricity in the evening, while small business, schools and other public actors, mostly consume electricity during daytime. Furthermore, business and schools have a higher Willingness-to-Pay for electricity, and therefore can be supplied at a higher electricity price. Electricity storage can therefore provide different benefits to different type of customers, who then also differs in their valuation of different storage options.

Previous studies have mostly analyzed the combined costs of solar PV/battery systems in rural contexts, but not the actual benefits that batteries provide. Benefits can be both economical (e.g. more electricity can be sold), and social (e.g. different appliances are used at different times, providing different benefits). Using data from real-world mini-grids in east Africa, the goal of the project is to analyze and provide estimates of the socio-economic impacts that battery provides in solar PV/battery mini-grids and what this implies for battery sizing for different types of customers and communities. Questions to be answered in a thesis project could be:

- What are the economic benefits of increasing the energy or power supplied by an energy storage in a solar PV mini-grid for different customers? And how do the marginal economic benefits change?
- What are the social benefits provided to households by increasing energy or power from an energy storage? And how do the marginal social benefits change?
- What does the different valuation of storage imply for the dimensioning of battery storage in mini-grids?

Answering of these questions requires an inter-disciplinary approach, combining economical, social and technical aspects and knowledge.

A background in M.Sc in Sustainable Energy Systems, Industrial Ecology or Applied Physics is advisable. Preferably experience with Matlab, Python or other modelling languages.

The thesis proposal is open to 1-2 master thesis students, who could either carry out their thesis independently or together.

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