

Project directive for Technical communication (FSP025) 2016

Rural Electrification in Developing Countries



Electrification of a Rural Village in Tanzania (RurElec)

As of 2014 1 billion people still lack access to modern energy services, mainly electricity. More than half of them are living in Sub-Saharan Africa and their lack of access to electricity has severe implications on their lives and their ability to improve their current situation. During recent decades Latin America and developing Asia have seen large improvements in electrification and today have access levels of around 90%. Still Sub-Saharan Africa lags behind with overall electrification levels around 30% and with rural levels often only reaching a few percentages.

The importance of electricity is crucial in our lives, regardless if we live in Sweden or in Tanzania. Lighting increases the time we are able to work and let us study in the evening, TV and radio gives us entertainment and acts as an important information channel for news and health, electrical machines improve productivity and increase economic performance.

In Tanzania about 14% of the people have access to electricity. In large urban areas such as Dar es Salaam, Mwanza, Arusha and Dodoma the share is much higher, but in rural areas only a few percentage of the people is estimated to have access to electricity. The Tanzanian Electric Supply Company Limited (TANSECO) is responsible for the generation and transmission in Tanzania. TANESCO are concerned about the extremely low access levels in rural areas. However electrifying rural areas is difficult and expensive. There are multiple technologies and possibilities that need to be evaluated, infrastructure is generally non-existent or very bad. TANESCO have therefore turned to Chalmers University of Technology for help to evaluate different options in a pilot project (Chalmers is known for its competence in the area of rural electrification).

TANESCO has found a pilot project village in the southern highlands of Tanzania called Bulongwa. Bulongwa is a medium sized village with an estimated population of about 3 000 people in the mountains of the southern highlands and currently lacks electricity access. The only way of reaching Bulongwa is by driving 3 hours by car on dirt roads (inaccessible during heavy rains) from the closest town, Njombe. Njombe can in turn be reached from Dar es Salaam by plane and car/bus (on paved roads). See the appendix for a map of Bulongwa.

Project specifications

The project reporting shall cover the following items (**when they are important to your solution!**) to help your customer evaluate your suggestions and decide how to proceed:

- A technological and economical evaluation of alternatives.
- An assessment of how the local/regional context impact on your solution.
- An assessment of your solutions future robustness.

RurElec A1 & A5 - Grid extension vs micro-grid

Your task as defined by TANESCO is to investigate which is the most suitable alternative to distribute energy to Bulongwa. The national grid is already extended to a nearby village 7 km from Bulongwa using 11kV power lines. However, the last stretch to Bulongwa is in a very mountainous area with peaks around 2200m and valleys at 1200m.

Your task is to make sure there is a power supply with enough capacity in Bulongwa, by either expanding the current grid or by building a local power plant.

RurElec A2 & A6 - Rural distribution system task

Regardless which solution TANESCO chose to implement for getting electricity to Bulongwa, people living there need to get access to electricity. Therefore the village needs a distribution grid. The village mostly consists of households but also several shops, a hospital and two schools.

Your task is to investigate different options and finally make a recommendation to TANESCO on a choice of distribution technology such as batteries, SWER, 3-phase and low voltage DC.

RurElec A3 & A7 - Electrification of hospital using solar PV

There is a large and modern hospital in Bulongwa (relative to the standard of rural hospitals in Tanzania). The hospital is today run using a diesel generator. The generator is very noisy and has a notable negative impact on the air quality at the hospital, which both patients and employees have complained about. As the village will be electrified by TANESCO the hospital board has managed to convince the TANESCO project leader to include an update of the current system. The diesel generator will be substituted for a solar PV battery system, which needs to supply 80 % of the current energy consumption (the rest will be supplied by the grid).

Your task is to recommend a solar PV/battery solution to supply 80% of the hospitals energy consumption. In figure 1 in the appendix you will find a load profile of the current consumption of the hospital over a day.

RurElec A4 & A8 - Alternative solution using Solar Home Systems

Electrification is expensive and like most government utilities TANESCO has a tight budget. They therefore want to investigate an alternative option for electrification using Solar Home Systems (SHS). SHS is a small solar PV and battery system. They have been shown to be very successful in Kenya and TANESCO are interested if they can be used for rural electrification in Tanzania.

Your task is to evaluate SHS as an alternative source of electricity for the people living in Bulongwa by comparing it to another electricity source (of your choice).

Appendix

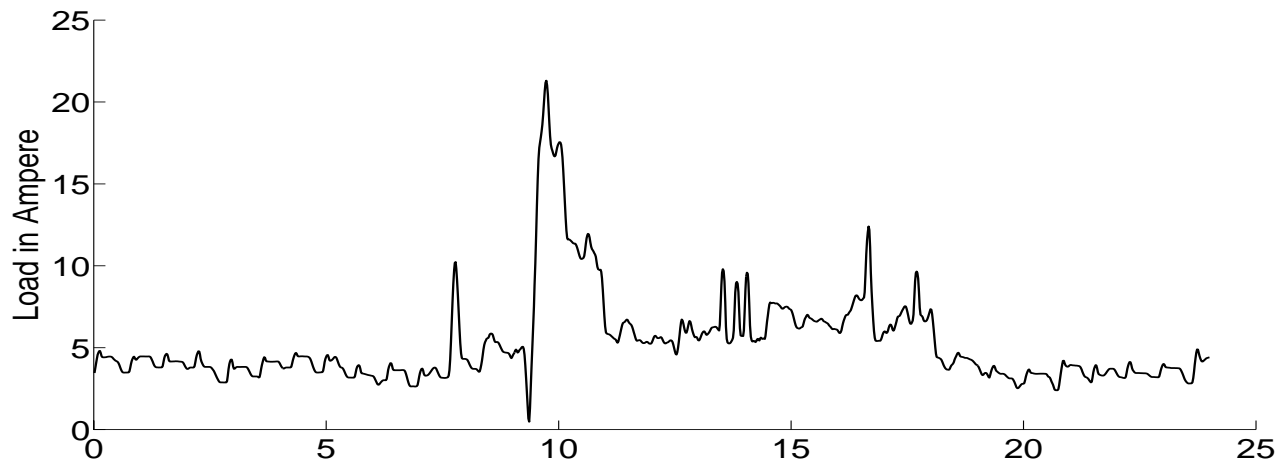
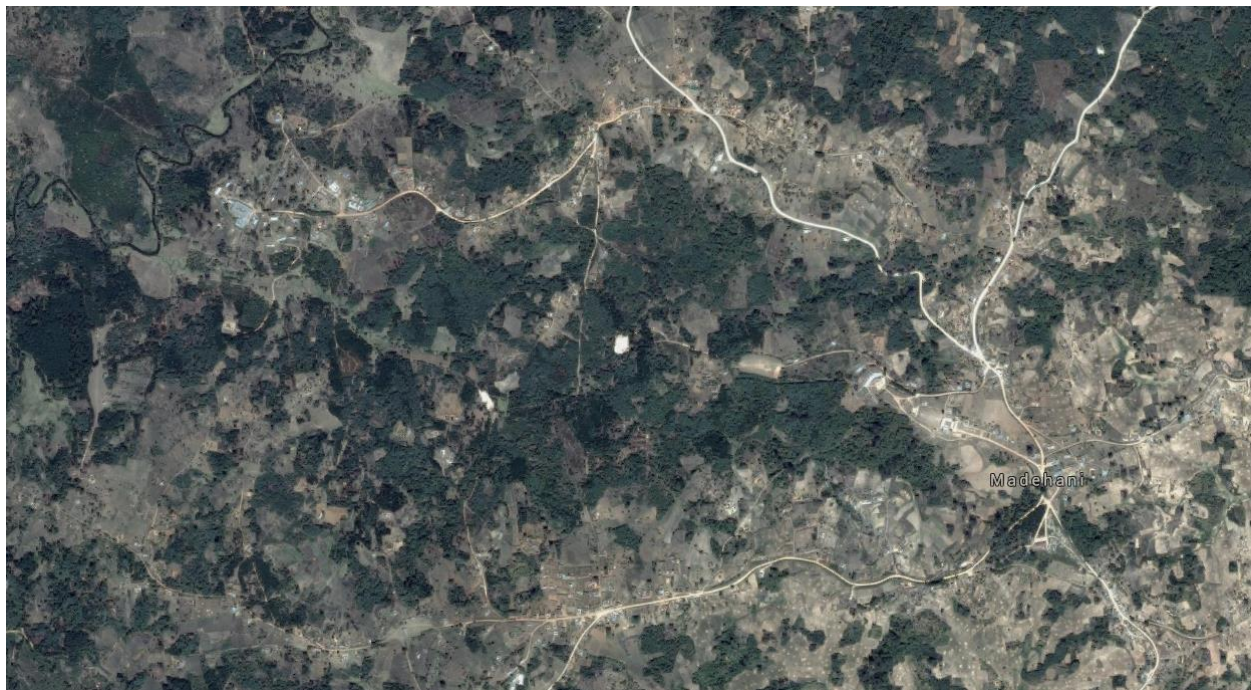


Figure 1 Load profile (in Ampere) for the hospital at one phase for a single day.

Map

Below are two maps over Bulongwa taken from google maps (<https://www.google.se/maps/@-9.336292,34.0445193,6458m/data=!3m1!1e3>). The first map shows the village inside the white marking, the location of the proposed hydropower plant and the hospital. The red marking shows the main market place of the village where most business and workshops are located.



-----| 1 km

The second map shows a possible connection point in Bulongwa (point A) relative to the closest grid connection point at the top. The distance as the crow flies between the two points is roughly 7 km.



Literature

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