Improving the representation of societal transformations using open-source stochastic tools for energy demand simulation in Bolivian rural communities

Claudia Sanchez-Solis, Jaime Zambrana, Sylvain Quoilin

Integrated and Sustainable Energy Systems (ISES) Research Unit, University of Liege, Belgium
Centro Universitario de Investigaciones en Energias. Universidad Mayor de San Simon, Bolivia
Instituto de Investigaciones en Ciencias Sociales, Universidad Mayor de San Simon, Bolivia

Introduction

To contribute to eradicate energy poverty, it is crucial to evaluate the electricity demand during energy planning. The most efficient electricity supply option and local generation capacity and storage system depend on the assumed local demand. Tools have been developed to support energy planning at different scales.

However:

- There are still challenges related to the demand side, that need to be addressed in the future.
- Energy system models have shown limited representativity of societal transformations such as actor behaviour, transformation dynamics over time, and heterogeneity between and within societies.

Fig 1. People from Raqaypampa Community

The Bolivian context

- Bolivia is a country in South America that has distinct geography, with various climatic zones.
- 32.7% of the population living in rural areas.
- Electrification rate of 93% reached.
- Aims to achieve universal access to electricity by 2025. Fig. 2 illustrates the population size and electrification rate in the near 19,300 communities of Bolivia.

The aim of this study is to provide inputs related to the social aspects of energy use to be integrated into energy system models for energy planning in Bolivia, through the generation of adequate demand profiles with the open-source stochastic tool RAMP.

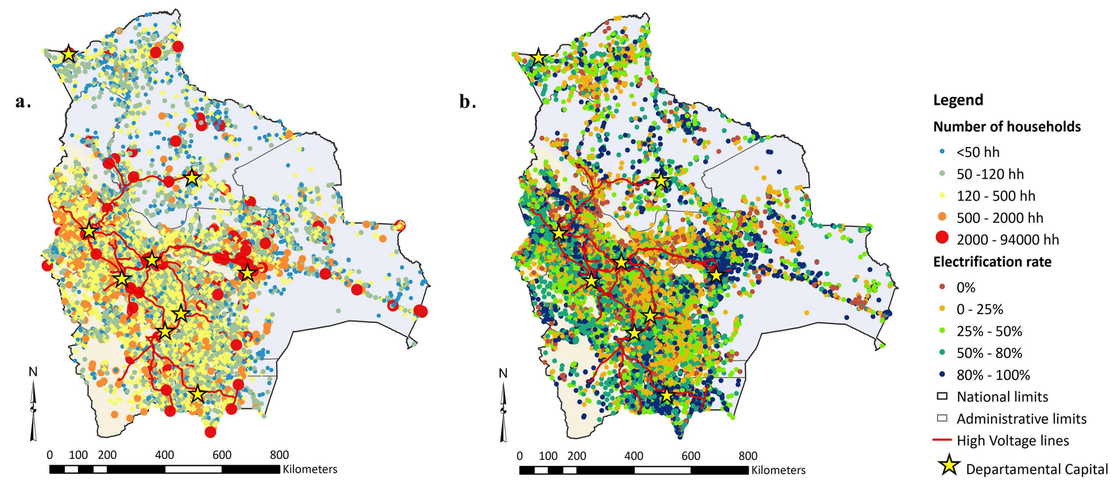


Fig. 2: Population size and electrification rate in rural communities in Bolivia (Peña Balderrama, 2020)

Fig. 3: One of the recipients of the Solar Home System in Raqaypampa (Case Study)

Methodological approach

Three main stages are proposed to adress these issues (Fig 4). Starting with ***case study in the Raqaypampa community*** *(Fig. 3)*, which will involve providing 100 households with Solar Home Systems (SHS) through a participatory process (step 1). The performance of the systems will be monitored, and a socio-anthropological study will be conducted in parallel. The results generated in the previous stage will be used to feed engineering models to estimate demand profiles (Fig. 5), specifically ***RAMP***, and define indicators related to the quality and quantity of service provided by SHS and grid connections with different levels of reliability (step 3). The challenge lies in the interdisciplinary nature of the work.

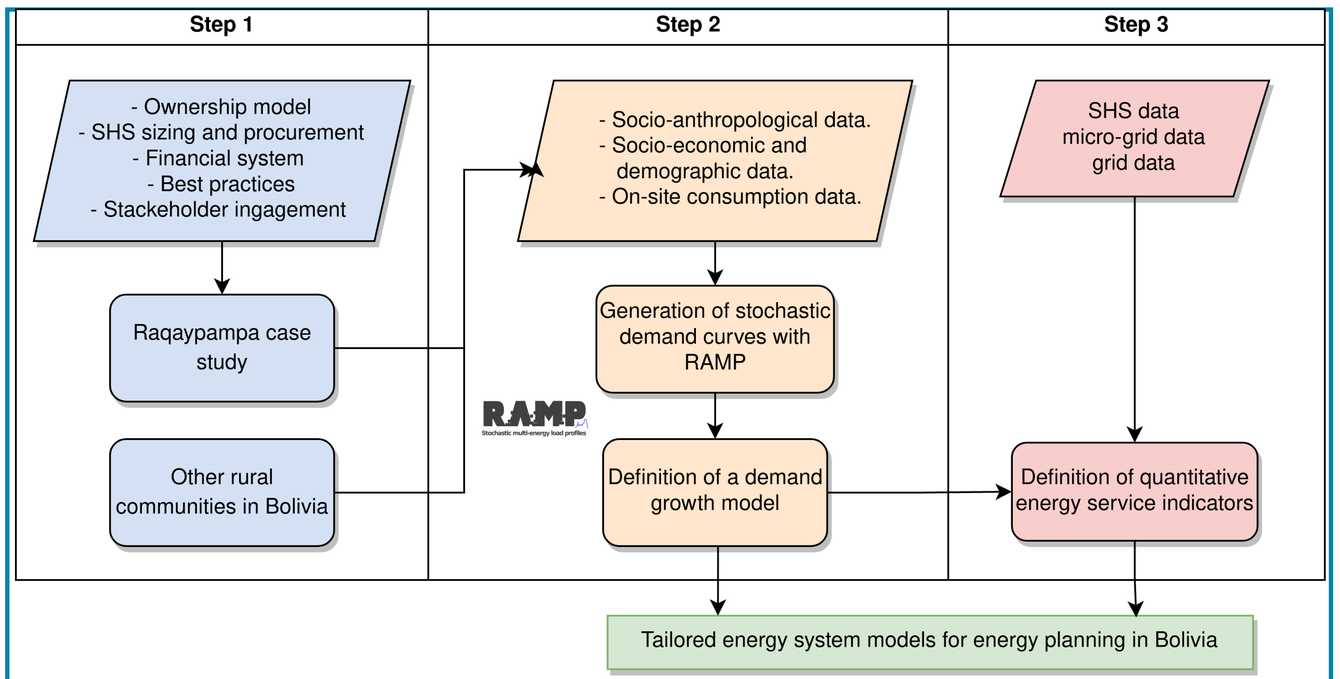


Fig. 4: Flowchart of the proposed methodological approach

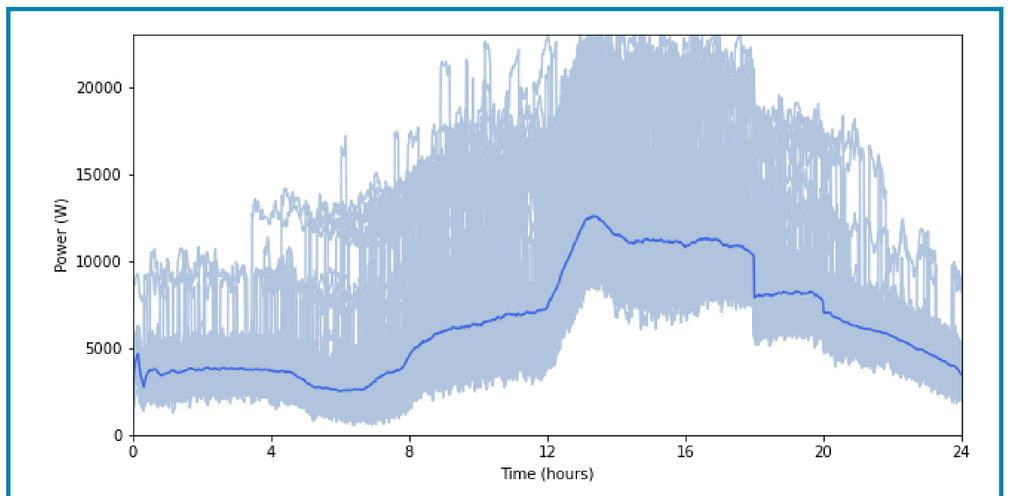
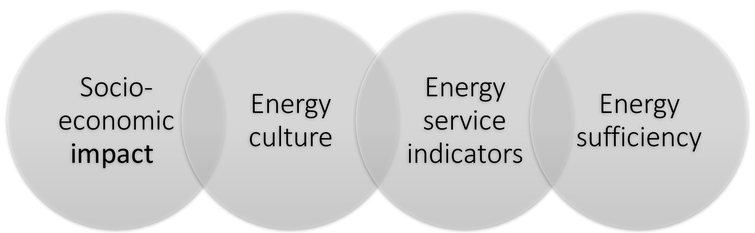


Fig. 5: Example of the stochastic daily load curves generated with RAMP (for 365 days), in a rural community of 200 inhabitants in the Bolivian lowlands. The darker line represents the average (Sanchez et. al, 2022)

Significant conceptual factors to be taken into account during the course of the study



Drawing upon these conceptual foundations, indicators will be revisited or constructed to facilitate ongoing monitoring throughout the electrification experience in the rural community of Raqaypampa (Fig. 3).

Recent advancements using RAMP, regarding this and other studies, are available in the following repository:

GitHub

References

Sanchez C, Betta PD, Stevanato N, Andersen L, Guzmán G, Quoilin S, et al. The Energy Sufficiency Concept and Its Impact on Energy Demand Estimation in Rural Communities from Developing Countries.

Peña Balderrama JG, Balderrama Subieta S, Lombardi F, Stevanato N, Sahlberg A, Howells M, et al. Incorporating high-resolution demand and techno-economic optimization to evaluate micro-grids into the Open-Source Spatial Electrification Tool (OnSSET). Energy for Sustainable Development. 2020 Jun 1;56:98–118.

Acknoledgements

ARES is acknowledged for the funding of this work in the framework of the PRD "Tailored Energy System Modells for Energy Planning in Bolivia"

Claudia Sanchez-Solis
PhD Student
E-mail: clsanchez@uliege.be
Twitter: @Claudia_LSS
Github: ClaudiaLSS