interactive multicriteria optimizer for designing microgrid wind-PV electrification systems considering managements constraints

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Stand-alone electrification systems based on a combination of solar and wind energy are a suitable option to electrify rural communities, since they complement to each other and ease continuity of supply. In addition, the combination of microgrids, for concentrated points, and individual supplies, for scattered houses, helps balancing microgrid benefits (flexibility in consumption, economies of scale, etc.) and cost increases due to grid extension. There are tools to assist the design of these systems, but they mostly focus on cost optimization and technical aspects. However, management issues (i.e. users' organization to operate and maintain equipment) have been proven essential to ensure the long-term sustainability of projects. Therefore, the multicriteria nature of the project demands a consequent approach in order to select a balanced electrification design considering economic, technical and social criteria.

In this context, this work develops the tool Microgrid Optimizer (MO) to design electrification systems (Figure 1) including multicriteria decision-making to contrast the economic and technical viability of the project with management and social considerations. In particular, constraints are introduced to adjust the number and size of microgrids, to guarantee equity between users and to maximize the social benefits for communities. The solutions obtained define the location and size of the equipment to be installed for electricity generation, storage and distribution.

The design process is structured in two decision levels to progressively define the detail of the electrification system. At the first level, several electrification alternatives are generated minimizing the cost for a set of different demand scenarios. These alternatives are ranked according to a flexible multicriteria decision process which allows modifying the default weights to give more importance to some particular criteria. Once the weights

of the first level criteria are adjusted, some solutions can be selected for further analysis in the second level. The alternatives generated for this second level consider constraints regarding the size and number of microgrids to ease the systems management. In the second level, criteria weights can also be adjusted, so the final solution can be adapted to the needs of both the community and promoters.

MO is supported on a free, easy-to-use web page which includes instructions about how to use the tool, a detailed explanation of the decision process and references to published articles in major reviews about energy topics. The user of MO is guided throughout the design process in an interactive environment, which covers from a template to introduce initial data in Excel form to reports of the design configuration. Moreover, the whole design process allows testing many design options in only a few minutes of computing time.

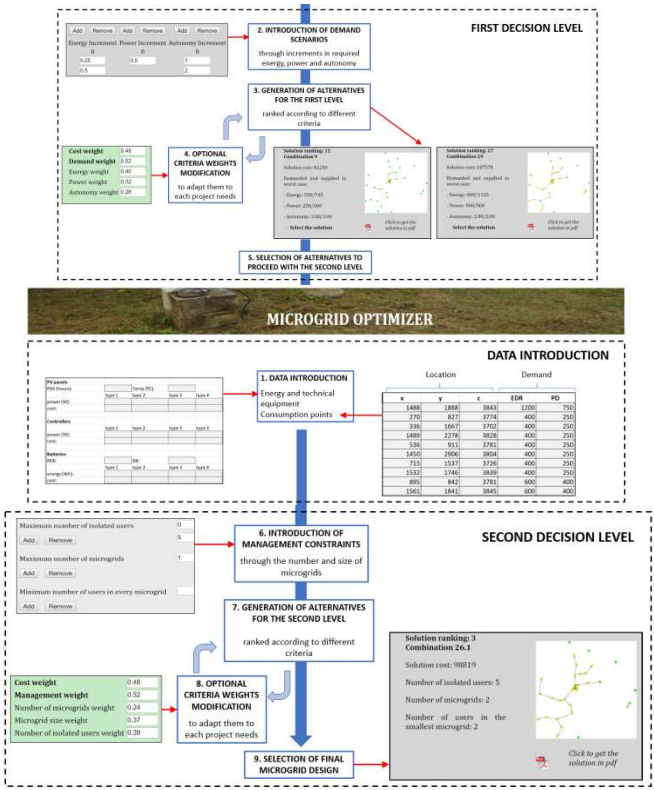

Figure 1. MO decision process illustrated by a flow diagram, complemented with captures taken from an example project