Minigrid electricity service based on renewable generation for isolated or rural areas: sizing criteria, management and sustainability models, and case studies in Africa and Europe

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Clean mini-grids (distributed energy generation and distribution systems based on renewable sources) are already a technological and operational reality worldwide, totally mature and able to supply grid-equivalent electricity services, particularly in rural and peri-urban areas with low population and remote from the national transmission grid.

In rural or isolated locations, the traditional extension of national electricity networks is technically and financially inefficient because of a combination of factors: (i) high investment costs, (ii) deficient grid supply (brown-outs, blackouts), (iii) long construction times, (iv) mid and long term increases of fossil fuels prices, (v) the recognition of the environmental benefit of renewable energy technologies, among other challenges to connect remote areas (e.g. submarine connections to islands, or security related aspects in areas with conflicts).

Properly designed and financed mini-grids, operated under an appropriate service scheme, are a suitable alternative to traditional electrification programmes, perfectly ready to be rolled out by public and private developers and accepted by customers and electricity sector actors in general.

This paper analyses the four (4) key components that conform sustainable electricity services from mini-grids (Social Development, Technical Reliability, Organisational Empowerment and Financial Viability), and describes case studies from existing mini-grids in Europe and Africa.

The recommended steps for financial analysis are:

- Twenty-year Life cycle and Annual flow of costs and revenues
- Discounted cash flow analysis (i.e. considering a discount rate)
- Cost breakdown by typology: (i) Capital (ii) fixed M&O&M[1] (iii) Fuel.
- Consideration of several technology options, and calculation of the specific costs breakdown for each of them (levelised cost US$/kWh, costs per connection).

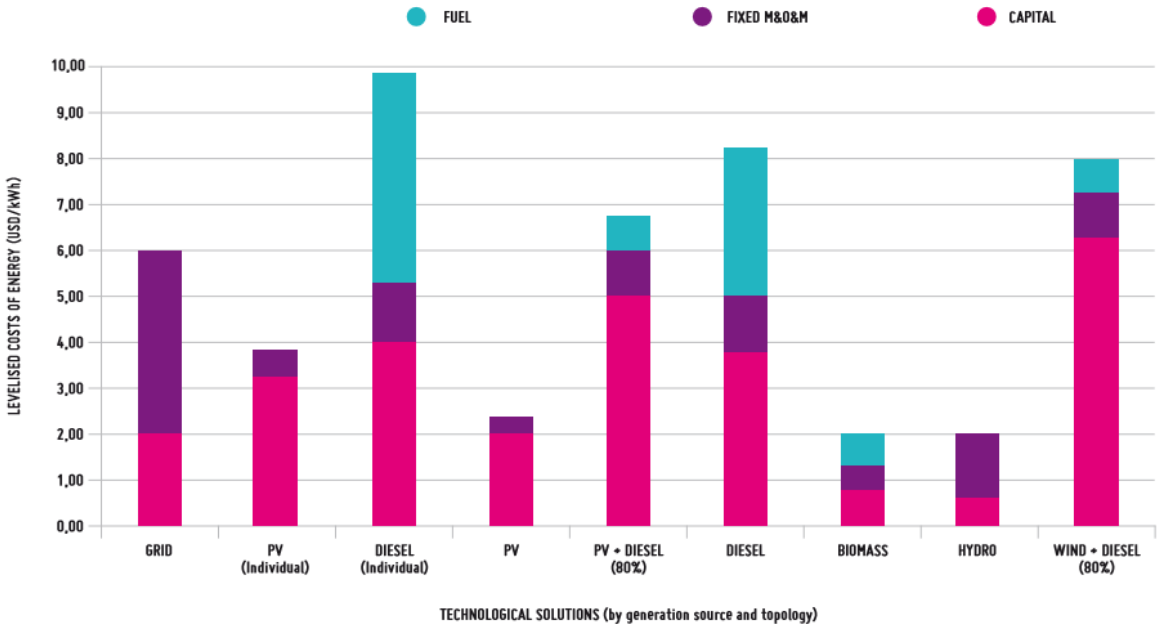

Figure 1. Spreadsheet example for cost comparison (life cycle) of 9 solutions (7 RE based) for a community of 20 families, where the solutions with the lowest specific cost would be a microgrid with biomass o hydroelectric generation.

Keywords: Rural electrification, Sustainability, Electricity services, mini-grids.

Conference topic: Decentralised renewable and household energy solutions

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[1] Management, Operation and Maintenance