RSVP RENEWABLES FOR SUSTAINABLE VILLAGE POWER

PROJECT BRIEF

Village Power Optimization for Renewables (ViPOR)

by Peter Lilienthal 7/98

Background

Throughout the world, many villages lack access to electricity. Many of these villages are so far from the utility grid that the cost of extending utility lines is more expensive than providing the village with its own autonomous electrical generation system. In recent years, wind and photovoltaic (PV) power have become economically viable electricity options for villages with sufficient wind or solar resources. Renewable resources can be used to supply power to many houses through a centralized distribution system, or for isolated systems serving a single house. ViPOR is a computational modeling tool capable of optimizing an autonomous village electrification system using the lowest cost combination of centralized and isolated power generation.

Scope

ViPOR represents the village as a set of demand points, each of which consists of x and y coordinates and an average daily electrical usage. Several economic parameters are required to calculate the costs of the distribution grid and the isolated systems. Centralized generation costs are calculated using the Hybrid Optimi-zation Model for Electric Renewables (HOMER), which has been integrated into ViPOR. The planned location (or several potential locations) of the centralized electrical power plant can also be specified. With such data, ViPOR conceptualizes the lowest cost system that will supply power to each demand point-either with an isolated power source (such as a small wind turbine or a solar home system) or through a centralized distribution grid. The design of the distribution grid involves the selection of the optimum location for the centralized power plant, the placement of multiple transformers, and the creation of a radial network of medium and low voltage lines. The voltage drop constraint is implemented using a maximum low-voltage line length, which limits the length of wire separating a demand point from its supplying transformer. An example of the output of ViPOR is shown below.

Status

ViPOR is a 32-bit Windows application written using Microsoft Visual C++. An alpha test version has been in development since May 1996 and is now operational. Currently, ViPOR is a model for NREL internal use. Analysis using ViPOR is done on a case-by-case basis.

Planned Activities

Several improvements are planned for ViPOR. They include explicitly calculated voltage drops at each demand node, wire costs being dependent on terrain, consideration of several wire and transformer sizes, and a method of accounting for different levels of service between centralized and isolated power systems.

Team Participants

- National Renewable Energy Laboratory
- World Bank
- National Rural Electrification Cooperative Association (NRECA)

NREL Contacts

Web site: *http://www.rsvp.nrel.gov*

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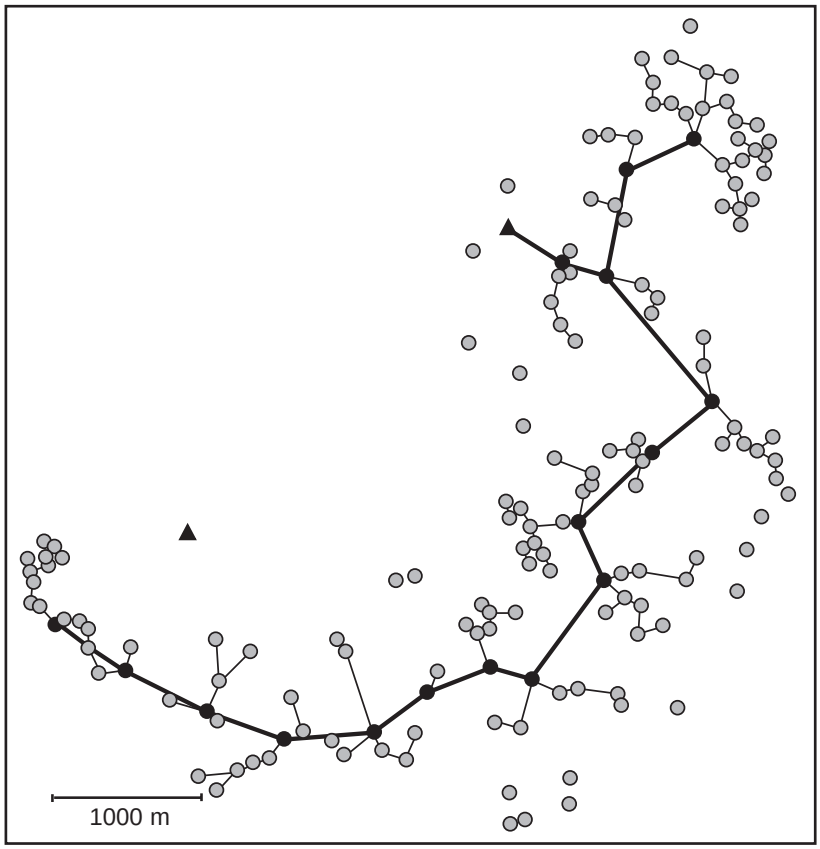
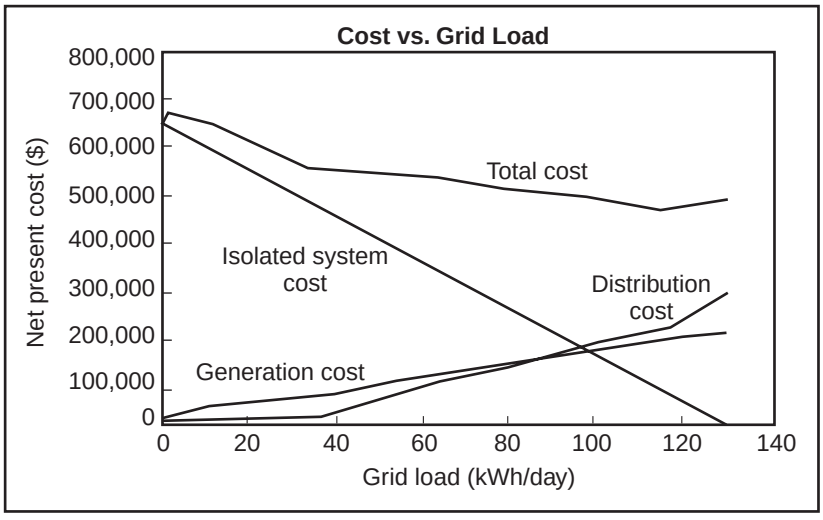


An example of the output of ViPOR. Lightly shaded circles represent houses. Those not included in the distribution grid were determined to be more economically served with isolated systems. Circles indicate transformer locations. Thin lines represent low voltage wires. Thicker lines represent medium voltage wires. Triangles indicate potential source locations; only the one chosen as optimal is included in the distribution grid.



In the cost versus grid load graph, the total net present cost of electrification and its three components are plotted versus grid load.