

# PROJECT BRIEF

## Sizing of Stand-Alone Power Systems for Rural Health Facilities

by Tony Jimenez 12/97

### Background

It is estimated that two billion people currently live in areas that lack electricity. Many of these areas will not be connected to the electric grid in the foreseeable future due to high grid-extension costs. However, areas beyond the grid can be serviced by a variety of stand-alone systems. These stand-alone systems can consist of combinations of photovoltaic (PV) panels, wind turbines and generators running on diesel, gasoline, or propane. Stand-alone systems range in size from small solar lighting systems that provide 100–200 watt-hours for lighting at night to diesel-powered minigrids with peak capacities of more than a megawatt.

In remote communities, the first facility to be hooked up to electricity is often the local health clinic. Traditionally, the power has been supplied with fossil-fuel generators. More recently, PV panels have been installed in some clinics to provide electricity. Wind turbine generators have received less consideration for providing electricity to clinics. Here we examine the least-cost options for providing stand-alone power to a clinic under a variety of climatic and economic conditions. In this study three load profiles were developed for typical rural clinics of different sizes. A stand-alone power system was designed for each load profile for three different climatic regimes including South Africa, Indonesia, and Brazil. Parametric analysis was performed to study the effects of wind speed, type of wind, fuel price, and capital costs.

### Typical Applications

Typically, health clinics require electricity for **lighting**, communication equipment and refrigeration. Electric lighting is vastly superior to candles and kerosene lamps. Often when a clinic is electrified, lights are included in the initial installation package. Due to the need to conserve power, most off-grid clinics use compact fluorescent lights that typically draw from 5 to 20 watts each. Even clinics that use daylighting need electric lights for emergency night care.

Emergencies also require reliable **communication equipment**. Electricity provides radio and satellite communications that enable the clinic staff to consult with specialists as needed and to arrange for the speedy evacuation of seriously ill or injured patients.

Health clinics also rely heavily on **refrigeration** to maintain the viability of medicines and vaccines. In the last 15 years great progress has been made in the development of vaccine refrigerators. These small, highly efficient, usually DC, refrigerators can be powered by a modest-sized solar array. Typical models draw 80–120 watts and will run for around 10 hours per day. Some super efficient models use even less energy. Even though they are expensive, these refrigerators are becoming increasingly popular and are considered so important that the World Health Organization has set standards for them. Like lighting, a vaccine refrigerator is often included in the installation package when a clinic is initially hooked up to electricity.

Other applications for electric power in clinics include small water pumps, ceiling fans, small sterilizing stoves, vaporizers, computers, centrifuges, and TVs and VCRs. The latter are used not only for entertainment, but also to show instructional and public health videos. Larger facilities such as district hospitals also may have additional laboratory equipment.

### Typical Clinic Services

- Inoculations
- Treatments for:
  - Respiratory infections
  - Venereal diseases
  - Diarrheal diseases
  - Skin disease
  - Eye disease
  - Malaria
  - Parasitical diseases

- Trauma: Burns  
Simple fractures  
Wounds  
Snake bites
- Pre-natal/post-natal care and child birth
- Dental
- Referral to hospitals
- Public health education
- Family planning

## NREL Contact

Web site: <http://www.rsvp.nrel.gov>

Tony Jimenez  
phone: (303) 384-6916  
fax: (303) 384-6901  
e-mail: [tony\\_jimenez@nrel.gov](mailto:tony_jimenez@nrel.gov)

## Typical Electrical Appliance Data

Item	Power (Watts)	Duty Cycle (hours/day)	Energy Use (kWh/day)
Lights	5-20	Varies	Varies
2-way radio	75	1	0.075
Refrigerator	60-120		0.3-0.7
Stove	200-500	1	0.2-0.5
Vaporizer 35-70	1		0.035-0.070
Ceiling fan	5-20	Varies	Varies

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