II. Understanding General Energy Needs

When considering the type of electrification needed to sustain daily operations, a facility must first understand its basic needs. The needs assessment will include an inventory of the types of equipment used in the facility and the power required to operate each device. Understanding the average "daily load", or the amount of power required to operate equipment under normal working conditions, will influence the choice of power supply. Once the daily energy requirement is established, a range of electrification options can be considered. Understanding the need will also provide managers with a realistic budget for procuring, installing, and maintaining the new system.

Calculating Your Health Facility's Energy Needs

Appendices A and B can be used to help health professionals identify the overall energy demands of their facilities and match that demand with an appropriate electrification solution. Appendix A, *Identify Your Health Clinic Category*, provides energy consumption estimates for commonly used equipment in various types of health facilities. Appendix B, *Estimate Your Energy Use* chart, can be used to tailor the information in Appendix A to a specific facility. After filling in the chart with your specific data, you will gain an estimate of your facility's overall energy demand. This information, in addition to expert consultation, will assist in the selection of appropriate electrification technology.

Strategic Thinking: Adjusting for Change

Once a facility has comprehensively analyzed the energy requirements of its day-to-day operations, it must be determined whether those demands are likely to change. Facility managers must think strategically about the possibility that energy demands may increase due to the addition of patients, extended operating hours, or new services. Once this process has been completed and an adequate accounting of needs has been made, the manager can determine the various energy options to meet those demands. These options must be considered in light of all facility-specific variables.

Categorization of Health Clinics

The following section describes several types of health facilities. The energy demands of a health facility will be a critical component in the selection of the most appropriate electrification technology. *Please note: these descriptions are provided as general comparative guidelines and are not precise descriptions of any one facility.*

Health Posts

Health posts are the smallest, most basic health facility. These locations typically will not have a permanent doctor or nurse on staff. The health post may have a full- or part-time primary healthcare provider. Services available at health posts include the treatment of minor illnesses, the tending of minor injuries and, where possible, the provision of basic immunization services. Due to the limited medical equipment used, the overall energy demand of health posts is relatively low. The energy demands of a health post will be satisfied through *Category I Health Clinic* electrification options, while taking into account the reduced daily demand for energy.

Lab technician preparing blood samples for grouping and cross-matching in a Haitian blood bank.

Health Clinics

Health clinics are generally larger than health posts and employ one or more full-time nurses. Clinics may also employ a part-time physician, depending on the size and location. A health clinic offers a wider array of services than a health post and will possess equipment allowing for more sophisticated diagnoses. Rural health clinics generally fall into one of three categories (*Categories I, II and III)*, based on the type and number of medical devices used in the facility and the frequency with which they are used on a daily basis. Local resources may make specific energy options more or less advantageous in each location. The categories are listed on page five.

Other types of health facilities that require reliable and sustainable electrification include blood banks, stand-alone laboratories and pharmacies, and anti-retroviral treatment (ARV) clinics. Blood banks, stand-alone labs, and pharmacies will, depending on their size, utilize equipment similar to that found in *Category I or II Health Clinics* and will have similar energy needs. ARV clinics will have significant energy demands similar to those found in a *Category III Health Clinic* or higher. Energy requirements could be intensive for some ARV clinics due to the computer technology and additional equipment required to perform rapid blood analyses.

Table I: Health Clinic Energy Needs on page six illustrates the estimated cost of various energy technologies for a range of clinic sizes. In general, renewable energy options (e.g., photovoltaic (PV) system) will have higher capital costs than diesel or other fuel-based electricity generating options. However, over the long-term, renewable systems will have lower operating costs and produce fewer or no emissions. In renewable energy systems, battery maintenance, occasional cleaning, and theft-prevention will be the major recurring

costs. A hybrid system using an alternative energy source (e.g., PV system) and a traditional generator (e.g., diesel) will have a higher up-front capital cost than a renewable-only system; however, hybrid systems provide greater flexibility, including the ability for one system to support the other. For illustrative purposes, a PV/diesel hybrid is represented in *Table I* on page six. Actual prices in a given location may vary considerably from those used in the table.

Category I Health Clinic (low energy requirements, 5 – 10 kWh/day)

- Typically located in a remote setting with limited services and a small staff
- Approximately 0 – 60 beds
- Electric power is required for:
  - lighting the facility during evening hours and to support limited surgical procedures (e.g. suturing)
  - maintaining the cold chain for vaccines, blood, and other medical supplies – one or two refrigerators may be used
  - utilizing basic lab equipment – a centrifuge, hematology mixer, microscope, incubator, and hand-powered aspirator

Category II Health Clinic (moderate energy requirements, 10 – 20 kWh/day)

- Approximately 60 – 120 beds
- Medical equipment similar to Category I Health Clinic; frequency of use and number of devices are key factors of differentiation between Category I and II health clinics
- Separate refrigerators may be used for food storage and cold chain
- Communication device, such as a radio, may be utilized
- May accommodate more sophisticated diagnostic medical equipment and perform more complex surgical procedures

Category III Health Clinic (high energy requirements, 20 – 30 kWh/day)

- Approximately 120 beds or more
- May serve as a regional referral center and coordinate communication between several smaller facilities and hospitals in large cities
- May need to communicate with remote health centers and hospitals by way of telephone, fax, computer, and Internet
- May contain sophisticated diagnostic devices (x-ray machine, CD_4 counters, blood typing equipment, etc.) requiring additional power

Refer to Appendix A for a sample list of equipment and related energy requirements for the different categories of health clinics. Refrigeration, lighting, and computers are assumed to be energy-efficient; all other devices listed are standard (not energy-efficient). The equipment list and energy requirements represented in Appendix A are an approximation, designed to provide the reader with a short-hand framework to better understand the information presented below.

Table I: Health Clinic Energy Needs

5kWh/DAY

Technology	System Size	Capital ($)	Operating ($/year)	O&M Assumptions
Solar Photovoltaic (PV) System with Batteries	1200 W panels 20 kWh batteries	$12,000 system $2,000 batteries	$500	1% of system cost per year (includes maintenance and component replacement, does not include security); Amortized cost of replacing the batteries every five years (20% of battery cost).
Wind Turbines with Batteries	1,750 W turbine 20 kWh batteries	$10,000 system $2,000 batteries	$600	2% of system cost per year; Amortized cost of replacing the batteries every five years.
Diesel Engine Generator	2.5 kW	$2,000	$1,400	$0.0075/kWh maintenance, $0.67/kWh fuel ($1/liter for fuel is used), operating at 4kWh per day at 50% capacity, and replacement of engine every 10 years.
Hybrid Systems	1,200 W panels 10 kWh batteries 500 W engine	$12,000 PV system $1,000 batteries $500 generator	$450	1% of PV system cost per year; battery replacement every five years; 200 hours of engine operation per year; replacement of engine every ten years.
Grid Extension	n/a	$10,000+ per mile	$200	$0.10/kWh power.

15kWh/DAY

Technology	System Size	Capital ($)	Operating ($/year)	O&M Assumptions
Solar Photovoltaic (PV) System with Batteries	3,600 W panels 60 kWh batteries	$36,000 system $6,000 batteries	$1,550	Same as above.
Wind Turbines with Batteries	5,250 W turbine 20 kWh batteries	$28,000 system $6,000 batteries	$1,750	Same as above.
Diesel Engine Generator	2.5 kW	$2,000	$3,900	Same as above, operating at 15 kWh at 50% capacity.
Hybrid Systems	3,500 W panels 30 kWh batteries 1.5 kW engine	$35,000 PV system $3,000 batteries $1,000 generator	$1,350	Same as above, with 200 hours of engine operation per year.
Grid Extension	n/a	$10,000+ per mile	$550	Same as above.

25kWh/DAY

Technology	System Size	Capital ($)	Operating ($/year)	O&M Assumptions
Solar Photovoltaic (PV) System with Batteries	6,000 W panels 100 kWh batteries	$55,000 system $10,000 batteries	$2,550	Same as above.
Wind Turbines with Batteries	8,750 W turbine 100 kWh batteries	$44,000 system $10,000 batteries	$2,900	Same as above.
Diesel Engine Generator	2.5 kW	$2,000	$6,400	Same as above, operating at 15 kWh per day at 67% capacity.
Hybrid Systems	6,000 W panels 50 kWh batteries 2.5 kW engine	$55,000 PV system $5,000 batteries $2,000 generator	$2,200	Same as above, with 200 hours of engine operation per year.
Grid Extension	n/a	$10,000+ per mile	$900	Same as above.

Energy Efficiency: Reducing Usage and Reducing Cost

As the table below indicates, a health facility can significantly reduce its energy demands by using energy-efficient appliances and devices. Typically, energy-efficient equipment and appliances are more expensive than standard-efficiency models. However, this higher cost is generally recouped through the reduced capital and operating costs of a smaller electricity generation system.

Description	Power requirement or energy consumption of a high-efficiency model	Power requirement or energy consumption of a standard-efficiency model
Computer	15 - 20 W (notebook computer)	40 - 80 W (desktop computer without monitor)
Computer Monitor	30 W (15" LCD monitor)	65 - 120 W (15" to 21" CRT monitor)
Electric Lamp	15 W (compact fluorescent lamp)	60 W (incandescent lamp with a comparable light output)
Refrigerator/Freezer	800 Wh/day	1,800 to 2,500 Wh/day

Installing more efficient equipment is an important component of energy conservation, but good management practices are equally important. These include maintaining equipment properly, insulating any areas that are heated or cooled, turning off unused lighting or equipment where possible, and monitoring energy consumption. All health center staff should be knowledgeable of the measures it takes to meet the center's energy needs and encouraged to help conserve energy.

Refrigerator storing blood and vaccines. Energy-efficient refrigerators can be used to conserve energy.