

Group D1  
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## Design Requirements

### I. Customer Requirements

Primary customers:

- Third World individuals / aid workers
- Natural disaster victims / rescue workers

Secondary customers:

- Hobbyists (do-it-yourself types)
- People in remote locations
- Individuals / homeowners

Requirements:

- Low cost
  - Cheap acquisition of parts (can acquire recycled parts)
  - Cheap to assemble
  - Virtually no operating cost (very little maintenance and no fuel cost)
- Simple
  - Made with material easily packaged in a kit (preferably with instructions)
  - Limited tools required to assemble
  - Can be assembled by two individuals with high-school education
  - Manageable size
- Versatile
  - Easily interfaced with electrical appliances (light bulb, radio, etc.)
  - Parts can be replaced (can accept variety of battery types, etc)
  - System can be recycled (parts that still function can be used to rebuild)
- Reliable
  - Provide electricity at night and during bad weather conditions
  - Relatively weather resistant
  - Functions apart from electrical grid (infrastructure not required)

The customer's needs were established by considering first the application and then considering the constraints on the customer's abilities and operating environment. Since the primary customer is either a Third world individual or a victim of natural disaster (or workers assisting them), money is an especially limited resource. Therefore, the product must be low cost, and the cost includes acquiring the parts (purchasing the product and finding any parts not included in the product), assembling the product, and operating the system. Preferably, the product would use recycled parts, or more appropriately *reused* parts, such as a battery from an old car or a motor from an old machine, which would eliminate the cost of buying new parts. Also, the user ought to be able to assemble the product with few included tools at no cost, since

the product would likely have to be shipped and would not arrive assembled, and the user would not have access to technical help from an expert. This is also the main reason that the product must be simple; likely two people of high-school-level education would be available to assemble the product given the tools and a set of instructions. Versatility is essential it will be used in varied small-scale applications and will be subject to lack of availability of specific parts, meaning it must accept many varieties. For example, if the product were to allow for the use of a recycled battery, it must be able to cope with a range of battery specifications. Finally, since the user will likely operate the product in a remote area in potentially poor weather conditions, it must be reliable, continuing to function in poor conditions and apart from an electric grid.

## II. Competition

Products currently on the market that meet a similar need are listed below. For each competing product the cost, size, and electrical specifications are given as a benchmark for the performance of our eventual product.

1. 90 hr Battery with charger
  - \$300 battery + \$110 charger = \$410
  - 120 lbs (21" x 9" x 10")
  - 150 Ah, 12 V, 20 W
2. Solar panels
  - \$258 + cost of battery
  - 13 lbs (21" x 26" x 2")
  - 40 W, 12 V DC
3. Gasoline powered generator
  - \$400 + gas money (fuel cost)
  - 76 lbs (21" x 14" x 24")
  - 1500 W, 12 V DC
4. Human powered generator and 13 hr battery
  - \$995
  - ~40 lbs (24" x 16" x 18")
  - 20 W (varies depending on human exertion)

## III. Design Requirements

Essential requirements:

- **Electrical specifications:**
  - Provide 20W at 12V DC
  - "Continuous," meaning 40hr backup (1 day without sunlight (24hr) + preceding night (16hr) = 40 hr); able to charge/discharge simultaneously
  - No photovoltaic technology (i.e. no use of photoelectric effect)
- **Assembly and maintenance:**
  - Must be able to be assembled and maintained by 2 high-school-level educated people
  - No fuel or plug-ins required

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Additional requirements (non-essential):

- Cost must be less than \$400
- Size – must have ground footprint of less than 2 square meters
- Must utilize at least 2 reused components (parts originally intended for other application)
- Must be able to withstand at least 1 inch of rain within a 24 hour period (provided that it is not located in a low lying area where flooding could occur)

### Development Process

In order to develop the information presented in this memo, the group combined intuition with web-based research. Knowledge of customer requirements from the Third World and disaster situations came from both second-hand sources and personal experience. Knowledge of the competition was arrived at by first brainstorming to consider the different technologies known to the group and then researching the technical specifications on the internet. The quantitative design requirements are a result of the customer requirements combined with the requirements to be competitive with the specifications of the currently existing products. The essential design requirements are those that deal with the specific application of the product and cannot be altered. The additional requirements are ones which, if met, would make the product more desirable and competitive, but it is not essential that they are met exactly.