Needs Assessment and Project Scope

EML 4551C – Senior Design – Fall 2011 Deliverable

Team # 7

Carlos Novelli
Jonathon Miller
Sean Stege

Department of Mechanical Engineering, Florida State University, Tallahassee, FL

Project Advisors

Dr. Srinivas Kosaraju, PhD
Department of Mechanical Engineering

Dr. Rob Hovsapian, PhD
Department of Mechanical Engineering

Reviewed by Advisor(s):

Needs Assessment

America has an overflowing supply of "trash", which contain a significant potential for future use. There is also a great need to turn to cleaner and more sustainable energy sources worldwide. This "trash" can provide the components necessary to design and construct a machine capable of generating energy, entirely out of recycled materials. These materials also have the benefit of being low-cost and easy to find, which is essential for third world countries, which do not have the financial resources to purchase new systems for green energy production. In order to help our environment and people in third world countries, a low-cost energy generating system can be made from these readily available trashed parts that can harness earth's renewable resources and power a family home.

Project Scope

Project Statement

The goal of this project is to take readily available parts from the trash of the "developed world" and create a family-sized generator that runs off renewable resources (wind power, solar power, hydropower). It must be cost-efficient, easy to assemble, very robust and require very little maintenance. The success of this project will prove that there is a great deal that can be done to help both our environment and people in need at a price that will benefit all parties.

Justification/Background

In many countries around the world there are people with no means of acquiring power due to lack of funds or parts to harness their surrounding natural resources. A family-sized generator would be a very valuable commodity for them and would greatly enhance their standard of living.

With planet earth's current energy crisis there is a huge surge towards using renewable resources to supply power. Around the globe people are turning to wind, solar and hydro power in order to reduce the amount of carbon emissions they are creating as well as obtain free sources of energy. Most common wind applications consist of wind turbines which harness the mechanical energy of wind turning the turbine. Mechanical energy is then converted into electrical energy with the use of an alternator. Hydropower is another abundant renewable resource that uses falling or moving water to rotate a turbine and produce mechanical energy. This mechanical energy can then be converted into electrical energy, similarly to wind power. Solar power can provide a substantial amount of energy due to its dependence on the Sun; however, solar photovoltaic cells are very expensive. Green energy systems made from new materials have a high cost, and the price is justified by building them in large scales. It is of great importance to provide a small scale device that would be affordable and effective in generating energy.

Developed countries have had increasing problems with the amount of garbage that is stuffed into landfills. Some of these components can have great value to third world citizens as they would otherwise have no access to them. Simple refurbishment will render most parts good as new and allow them to get a second life. This will greatly benefit developing countries that are in need of a low cost energy system that is environmentally clean. At the time will reduce the amount of garbage contained in the landfills of developed countries.

Objective

Design and construct a power generation system composed entirely of recycled materials. Power generation will implement the use of renewable energy sources, such as wind power, hydropower, or solar power. Three locations in developing countries will be chosen where the power generation system will be functional and capable of generating 12 V DC current at a rate of 100kWh per day for a total of three days. Each location must be 100km form the coastline and 500km away from each other. The system will also accommodate for the infrastructure and available resources of the developing countries of choice and the finalized product must cost under $50.

Methodology

To begin the design and construction of our power generation system, extensive research will be conducted to answer the following questions: Which renewable energy source will meet our objectives most efficiently? Based on the renewable energy source selected, what are the three best locations in third world countries that are capable of providing this specific energy source? What "trash" or recycled materials are readily available for constructing this system that will meet our financial requirements? Completion of this background research will involve online sources for energy theories and geographical information, as well as physical observations in junkyards and dumpsites for material selection.

Once the background research has been completed, theoretical calculations will be performed to determine the size and specifications of the mechanical and electrical components. Once the theory is completed, team members will decide on which materials will be purchased and manage our budget. Upon purchase, extensive testing will be performed since the equipment will consist of used, and refurbished components. Some educated trial and error will also be practiced to enhance efficiency on small scale components.

To finalize the design and initialize the construction of a fully-functional power generation system to meet our objectives, we will implement a systematic decision making process. This decision making process will classify each component into four categories: Electrical production efficiency, cost, ease of manufacturing and durability. Using this method we can ensure a working product with high consideration of all possible concepts.

Constraints

As in all engineering projects, there are certain limiting factors that must be taken into account. These constraints will be key in our decision making process to come up with the optimal generator design for a developing region.

- A functioning prototype must be built with a budget of $2000.
- The individual kit price must be kept under $50.
- It must be easy to assemble and operate safely.
- Each location must be 100 km. from the coast and 500 km. apart.
- The device must be capable of producing 100 kWh/day and have a storage capacity of 300 kWh.
- It must generate electricity from renewable resources such as wind, sun, or water.

- The majority of the materials used should come from scraped materials.
- The system will operate at 12 volts DC.

Expected Results

At the end of this design project, a fully functioning, renewable energy based generator will be developed. The system will be capable of producing 100 kWh/day and have a storage capacity of 300 kWh. While the kit will only cost $50 (US), it will be easy to assemble using everyday tools that the indigenous people have on hand. Furthermore, the system will be robust and reliable enough to meet the needs of a small family in a developing region. By working together as a team in a time effective manner, these results should be easily attained.