Solar Powered Water Pump

June 13th 2013



*The water resources in Africa are distributed throughout the continent. You find both extremes, some areas receive more than average amounts water while others experience constant drought. Every day in rural communities and poor villages throughout the sub-Saharan Africa, hundreds of millions of people suffer from a shortage of fresh and safe water. The lack of clean water causes hunger, poverty, poor education and bad health conditions. In addition people from all ages have to walk daily miles away from their home in order to have access to a water source. As technology is progressing, the ways of collecting energy and natural resource are also in developing stages. To answer the need of the people in Fawomanye, a small rural agricultural village in Central Region in Agona District, Ghana, the introduction of more efficient ways to collect water is required. There are many avenues to collect fresh water in pumping technology such as gas, wind, solar, hauling, ram and gravity water pumps. Out of the list of water pumping methods cited previously, the outstanding technology is the solar powered water pumps. By successfully applying this technology into Fawomanye, I am confident that many positive outcome will result out of it such the improvement of the life quality which includes health, poverty and education. Further research need to be done on ways to reduce the cost of solar panels by finding a different cheaper material to use as a photovoltaic cell instead of the expensive silicon. The reduction of cost will facilitate the introduction of many solar water pumps into Fawomanye.*

NSERC Undergraduate Student Research Awards Program

268 Robert N. Street  
Toronto, Ontario  
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June 13th 2013

Dear Sir/Madam,

I am writing to you regarding the funding of my research proposal entitled “Solar powered water pump”. This research will attempt to improve the efficiency of solar water pumps and it’s compatibility with African environment. I intent to convert the solar energy into electrical energy which is used to pump water.I am currently studying for my bachelors in mechanical engineering under the supervision of Dr. PragasenPillay, with experience in the field of Renewable energy such as solar and in energy efficiency .I will attempt to carry out this project in Concordia’s mechanical and electrical laboratories as well as open fields for sunlight exposure.

Not only that this research will allow me to enhance the productivity of solar water pumps and lead to a more eco-friendly society but it will also change people lives in Africa. Hence I am requesting a funding of $6,000 for this project, the estimated time period from June 20th 2013 to August 30th 2013. This amount will be used in designing, material processing, fabrication and test processes.

Sincerely,

**Table of Contents**

**Introduction to Africa’s Current Water Problem………………………………………...…...5**

**Proposed solution, methodology, materials, justification and conclusion…..………..….…...7**

**Schedule………………………………………………………………………………………....10**

**Budget…………………………………………………………………………………….……..11**

**Qualifications…………………………………………………………………………………...12**

**Press release……………………………………………………………………………………..14**

**References……………………………………………………………………………………….15**

**Introduction to Africa’s Current Water Problem**

There are many organizations that share similar interests as me with regards to renewable energy and the concern for the African water shortage. Of those companies is “NSP-New Solar Pumpe.U.” This organization is expert in many other technologies as well as solar water pumps. They sell solar pumps to needy places in Africa for very good prices.

The basis of life is water. In North America and many other parts in the world the water is daily being abused in an incredible way that we even forget about itsusefulness and meaning. Thefresh water in first world countries is so abundant that they forget other parts of the world that are suffering from the lack of this life source. If we look at the condition of sub Saharan countries like Malawi,Nigeria,Togo, etc., we find great misery and lack of water.The UN, in their studies, have shown that an average person requires **50 liters of water per day** in order to prepare meals and to have enough for personal hygiene. This amount of water is just enough in order to avoid diseases and to stay in good health. However, the average Canadian uses 274 liters of water per day while Africans **must get along with 20 liters water per day.**

In the western world, we simply need to untwist the tap while Africans must seek the water from far distances. Women and girls walk up to 4-6 hours per day to get water for their families.**Currently, over 300 million people don’t have access to clean water in Africa which represents around**40 % the total population. Moreover, about 60 % of the population lack proper hygiene. Additionally, the growth of the population will require the population to use more water and will increase the water shortages.Many diseases occur from polluted water. For example, early death of children is caused primarily by polluted water. The youth require fresh and clean water in order to develop their bodies and to properly grow. Because clean water and hygieneis lacking in these countries, pathogens and parasites spread quickly. Common diseases that occur from these microorganisms are diarrhea and malaria. **Some studies have been done on the subject of non-fresh water in Africa and the diseases that relates to it and it was found that “4 billion**cases of diarrhea caused **2.2million** deaths.” Also, “**352 m**illion humans in Africa are affected by malaria every year”, this number represents 88 % of the cases worldwide. In addition to the diseases and deaths caused by the lack of clean water and hygiene, other consequences arise from this issue are:hunger, poverty and poor education. By lacking fresh water, less vegetation can be harvested and so less food is produced. Also, the shortage of clean water has serious effects on students’ academic performance and their attendance rate. Without clean water the student’s focus decreasesand kids are required to collect clean water from a far distance to answer their family’s needs. Thehardships and diseases resulting from the lack of water mentioned above also applies to Fawomanye.This village has about 300 people who rely on surface water for drinking, cooking, bathing, and washing. Many diseases are also spread because the unclean water and the travel to access this water is at a great distance from the village.

**Proposed solution**

Since I have always been fascinated with field of solar and renewable energy, I have been thinking of ways to improve solar water pumps, their cost and maintenance in African territories. The solar water pump runs with use of solar panel technology.To begin with, the rays from the sun shine on the solar panels then the photovoltaic cells on the panels convert sun energy into direct current. Next, as the current is travelling towards the electric motor, it passes through a control box. The box controlsthe input energy from the solar panels andenables the pump to run in low light conditions. Sometimes the energy produced is too low to make the motor work, so the control box will block these currents from reaching the motor. Without the control box, the weak energies will damage the motor with time. Furthermore, as the current passes the control box it reaches the motor and activates the pump which then causes the water to move and are finally deposited in the water tank. Although the control box is an expensive part, its presence is crucial for the performance of the electric motor.

The implementation of solar water pumps in Fawomanye can be a great challenge for my project because of the high cost of the conventional solar panels made from silicon as well as their maintenance. Solar panels constitute about 80% of the water pumps’ cost. In addition, one of the very few maintenance problems with photovoltaic pumping is the possibility of breakdown of pumps but not the failure of the photovoltaic devices.

A technology that still needs some research and experiments is utilizing organic instead of inorganic (silicon) photovoltaic cells. Organic cells are made of carbon which is basically plastic. It is a material that is cheap, abundant and less harmful for the environment. This new technologywould be the ideal implementation into Fawomanye’sequipmentknowing their current poorsituation. There is no doubt that silicon would be more efficient for solar energy collection than carbon based cells but nonetheless it will still do the job. If we are looking to optimize the cost as well as the availability of solar water pumps in that village then organic photovoltaic cells panels are the best option.

The design and conception of the carbon based photovoltaic cells will be done in the university’s laboratory under the supervision of Dr. Pragasen Pillay.

**Material**

First of all, I would need access to a manufacturing lab and an electric lab, to assemble the solar panel and design and conceive the new type ofphotovoltaic cells (Organic Photovoltaic cells). I would also require a multimeter to test the flow of current passing through the solar panels. I would also require two 250 kW solar panels, a control box, an electric pump and 20 m of wiring.

**Justification**

If my project is successful, it would be a significant contribution to Fawomanye. The installation of solar water pumps would provide clean and safe water for this village. Today, one of the greatest challenges for the people in Fawomanye is the access fresh and safe water.If the project is successful, it will drastically reduce diseases, poverty, early deaths, hunger and would save people hundreds of hours a month that could instead be spent in school, nurturing children and agricultural activity.This place where clear, clean and safe water is unknown, solar water pumps would make people find hope, make them more focused and goal oriented. Solar water pumps will also propel Fawomanye technology and people will have the chance to think further about improving their lifestyle since water will be available.

**Conclusion**

The Solar powered water pump has a promising turn out in the African territories because of the many advantages it holds. As the world become more aware about the misery and the hardship they have to endure every day simply to barely stay alive, we will definitely become more and more eager to take action in helping our brothers in humanity with their problems.by me being aware of their current situation, I would like to take the initiative at contributing to part of their needs by implementing solar water pumps all around Fawomanye’s small village. These water pumps would not only reduce the rate of illness of the population but it would literally save the lives of the people who would otherwise die due to pathogens and other viruses found in their unclean drinking water. Kids will be able to go to school, parents would be able to take care of their children and everybody will be able to set up new goals in their lives. All these benefit arise from the pure substance that this village lacks. This project will not only benefit a household on its own rather the whole community of Fawomanye. For this reason, I request you to fund this project in order to support our brothers in need.

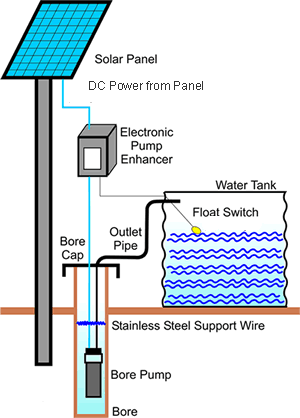
**Schedule**

**Since carbon photovoltaic cell panels are not available in the market for first purchase we are forced to buy silicon solar panels.**

|  |  |
| --- | --- |
| Week 1 | * Design the solar water pump using solid works * Order the required parts * Prepare the laboratories |
| Week 2 | When the order is received, check the functionality of all parts (especially the solar panels and electric pump) |
| Week 3 | Because we have all the required parts to make the water pump function, we can start working on designing carbon based cells instead of silicon photovoltaic cells in order to reduce the cost of the solar panel purchase so we can design more panels to send them to Africa. |
| Week 4 | Continue improving the solar panels |
| Week 5 | Continue improving the solar panels |
| Week 6 | 1st attempt: expose our new design to the sun and see its reaction. |
| Week 7 | If everything works out, in this week start assembling all the pieces together. |
| Week 8 | After assembly, take the entire system to a near lake or water source and test the entire body. |
| Week 9 | Take out the entire system to any water point once again and leave it for an entire day in order to see the pumping results and if nothing breaks down. |
| Week 10 | Complete final touches on the entire body and the solar water pump with the new cheaper technology of carbon based photovoltaic cells is ready to be shipped to Fawomanye’s village. |

**Budget**

|  |  |  |
| --- | --- | --- |
| **Item** | **Quantity** | **Cost** |
| Solar Panels | 2 | $3000 |
| Control Box | 1 | $100 |
| Borehole | 1 | $1000 |
| Bore cap | 1 | $70 |
| Wiring | 20 meters | $60 |
| Outlet pipe | 1 | $80 |
| Water tank | 1 | $800 |
| Float Switch | 1 | $100 |
| Electric Pump | 1 | $400 |
| Multimeter | 1 | $50 |
| **Total** | **-** | **$5660** |



By looking at the list of items, I would like to request a maximum budget of $6000, in order to successfully carryout my project. Furthermore, there will be no costs of labor as the only participants are Dr. PragasenPillay and I.

**Qualifications**

Dr. PragasenPillay is a reputed professor in Concordia University’s department of Electrical & Computer Engineering.Dr. pillay is a member of the Institute of Electrical and Electronics Engineers (IEEE).Of the many fields of expertise of Dr. Pillayare energy efficiency, renewable energy, including wind, biomass and solar energy and Electric motor drive systems.Pillayfocus his research on electrical machine drives for industrial and alternate energy applications, power quality and energy efficiency. His research received a funding of $1 million, from various institutions including Delphi R&D, NASA, General Motors R&D, U.S. Navy ONR, Electric Power Research Institute, Entergy Corporation, Lockheed Martin, Consolidated Edison of New York and much more.In addition, he has received numerous awards and honors such as the“IEEE Industry Applications Society Annual Meeting Prize Paper Award”in 1987 and 2003.Also, he received the“IEEE Power Engineering Society’s Working Group Award” in 2001 for developing a video on power engineering education. Moreover, Dr. Pillay is a member of the “Academy of Science of South Africa”. To add to his awards and honors , Dr. Pillay also published more than 60 professional peer reviwed articles on the IEEE Transactions. Of the publications of this professor are:

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The achievements of Dr. Pillay are countless, for this reason I strongly believe that he is the perfect fit for my project’s supervision. His exceptional expertise in renewable energy is what led me to choose him as my supervisor.

My name is Amer Mansour and I am a John Abbott College graduate in pure and applied sciences. In one the science classes that I took over there (astronomy), as a team we had to come up with the use of current tools and materials, ways to create a ring world. In this project we made use of carbon nanotubes, solar panels and titanium for the built of this ring. I have always been motivated in renewable energy sources, solar panels and different types of materials. Furthermore, I have decided to study my major in Mechanical Engineering from Concordia University. I started my education in fall 2012 and I am expected to graduate by fall 2016. In the following semester (Fall 2013), I will be undertaking an internship and cascade Inc. . This company is ideal for me since most departments deal with energy projects,ways of using energy more efficiently and methods to reduce the pollution. Since I have an interest as well as some basic knowledge and experience in field of photovoltaic cells (Solar Panels), I am bound to say there is going to be an excitement in working on this project.

**Press Release**

Water is the basis for life! Since a long time the shortage of clean water in Africa has caused poverty, poor education and bad health conditions .Studies have shown that 40% of Africans don’t have access to clean water and 60% lack proper hygiene.Moreover, in a lot of villages people have to walk great distances to obtain water and yet still unclean!For this reason, an undergraduate student in mechanical engineering, Amer Mansour under the supervision of Dr. PragasenPillay presents the only solution for this issue,“SOLAR WATER PUMPS”.By implementing this technology into African territories, less disease will be common, people can utilize their time into other important tasks such as school, agriculture and kids nurturing and people can become more focused and goal oriented. Furthermore, this bright innovation operates using the photovoltaic effect. As the sun light shines on the solar panels, the photovoltaic cells convert the sun energy into direct current and the pump then activates and start moving water into tanks. All in all, the quality of life will be better.This project is expected to be sent to Africa as early as mid of September 2013. Undergraduate engineering student, Amer Mansour says, “These solar water pumpsare low maintenance, no fuel cost and easy to install. It’s life changing.”

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