Solar Applications in Chad

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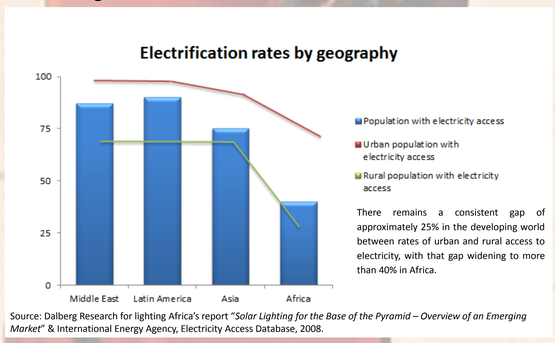
1. Abstract:

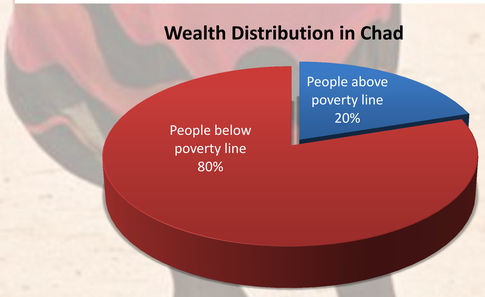
This project uses photovoltaic technologies for the applications of water pumping and lighting in the rural villages of Chad, providing people with greater development opportunities. Research reveals that 70% of the population does not have access to electricity, and most people have to travel at least 2.5 miles to get access to a source of drinking water. Since 80% of the people live below the poverty line, external funding would be necessary to make this project feasible. If funding is provided, this project can be a success in providing affordable lighting and clean water; and can be used as a model for other developing nations.

2. Background of Chad:

- Electricity: Production: 100 million kWh (2008 est.), World Ranking: 194
  Consumption: 93 million kWh (2008 est.), World Ranking: 194
- Only 50% of population has access to a source of potable water.
- People in some villages need to walk 2.5 miles to get clean water.
- Climate: tropical in south, desert in north, dry in nature.
- Population below poverty line: 80% (2001 est.).
- Literacy (people age 15 and over that read and write French or Arabic): 25.7%.
- Mobile phone usage: 2.686 million of 10.8 million (24.97%) (2009), World Ranking: 119.



Source: Dalberg Research for lighting Africa's report "*Solar Lighting for the Base of the Pyramid – Overview of an Emerging Market*" & International Energy Agency, Electricity Access Database, 2008.



Source: Countries and Their Cultures. (2006). *Chad*. Retrieved November 12, 2011, from http://www.everyculture.com/Bo-Co/Chad.html

3. Project Goals:

To effectively use photovoltaic technologies to provide the people of Chad with access to clean drinking water and electricity; thus increasing the quality of life of the people, and providing them with self-development opportunities.

4. Research Methodology:

Background Investigation:

- Selecting Chad:
  - Location: gets large amounts of unobstructed sunlight
  - Extremely low Human Development Index rating (183)
  - Politically stable
- Geography:
  - Typical village setup
  - Current energy sources and technologies
  - Current consumption levels of water and electricity

Technological Facts:

- How much power actually required
- How to minimize cost and maximize the efficiency of the photovoltaic cells
- Basics of solar lighting, LED lights, and solar powered water pumps
  - The output of an LED light, size of PV cells, storage of the solar energy after conversion, lifespan of the devices, maintenance requirements of the system
  - Most importantly, the conversion and storage efficiency

Marketing Strategies:

- Visually appealing and easy to use design
- Seminars and advertisements
- Training sessions extremely useful
- Work with local authorities

5. Results:

In a small mock village of about 200 people, assuming an average family size of 4.

Solar System
Solar Panel(s): 2 panels at 250 Watts each
Dimensions: Approximately 40"x65"x2"
Lanterns: 50 LED lanterns

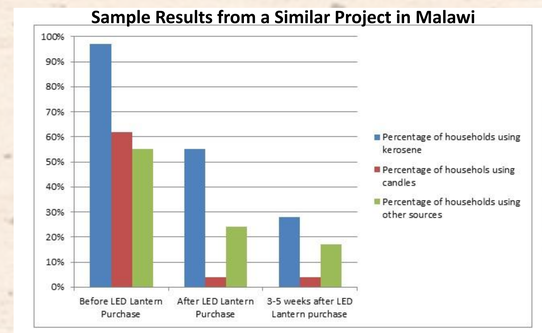
Pump:
Model: Quad Solar Pumps: 535440-BL40Q
System Power: 24V DC
Pumping Head: 92' (40 PSI)
Pumping Period: 10 hours
Amount of Water: 1800 gal/6813 L

Filter:
Pelican Filter System: PC600
Dimensions: 18"x18"x49.5"
Operating Pressure: 25-80 PSI
Max flow rate: 10 GPM
Connection size: 1"

Storage Tank:
American Tank Co: 2500 gal Cone tank
Weight: 889 lbs (without water)
Dimensions: 89" wide X 96" tall

Cost Breakdown:
(for mock village)

Pump (with solar panel)	:	$1,770.00
High Level Cutoff Regulator	:	$125.00
2500 gallon Cone Tank	:	$2,200.00
Carbon Filter	:	$750.00
Piping and other materials	:	$500.00
Solar panels (for lighting)	:	$900.00
Lanterns	:	$1500.00
Wiring and charging materials	:	$300.00
Total	**:**	**$8045.00**



Source: Adkins, E., Eapen, S., Kaluwile, F., Nair, G., & Modi, V. (2009, December 8). *Off-grid energy services for the poor: Introducing LED lighting in the Millennium Villages Project in Malawi*. Retrieved November 10, 2011, from http://www.sciencedirect.com

6. Conclusions:

To implement this project successfully, organizations need to provide funding and must:

- Hold systematic demonstrations and instructional programs on the use of the technology, with special emphasis on training women.
- Conduct seminars to convince people that technology will help them in their daily routines by adding more hours to their day to complete other tasks.
- Explain to the people the benefits of time, education, better health, electricity, and easier access to water.
- Make the people understand that this project leads to small scale enterprise development in the long run.
- Train the villagers to undertake small-scale maintenance of these systems, even though the proposed technology has an extremely long life span.
- Establish lines of communication with the company providing the equipment, so that the company can be contacted if technical assistance is required.
- Work with the village authority to ensure the security of the photovoltaic system.

7. Sources:

Adkins, E., Eapen, S., Kaluwile, F., Nair, G., & Modi, V. (2009, December 8). *Off-grid energy services for the poor: Introducing LED lighting in the Millennium Villages Project in Malawi*. Retrieved November 10, 2011, from http://www.sciencedirect.com

AFFORDABLE SOLAR. (2011). Retrieved November 22, 2011, from http://www.affordable-solar.com/

BRITTANICA (2006). *Refugee: Chad*. Retrieved November 28, 2011, from http://www.britannica.com

Peet, R. Creighton. In-person interview. November 2, 2011.

Pelican Water Systems. (2011). Retrieved November 22, 2011, from http://www.pelicanwater.com

Stephen, K. (2002). *Renewables in Africa—meeting the energy needs of the poor*. Retrieved November 11, 2011, from http://www.sciencedirect.com/science/article/pii/S0301421502000587

REEEP(n.d.). *Policy DB Details: Chad (2010)* . Retrieved November 20, 2011, from http://www.reeep.org/index.php?id=9353&special=viewitem&cid=131

Robinson Solar Systems (2010). *Where there's a well there's a way.* Retrieved November 17, 2011, from http://www.solarpumps.com/products.html

The World Factbook (2011, November 15). *Chad*. Retrieved November 21, 2011, from http://https://www.cia.gov/library/publications/the-world-factbook/geos/cd.html

WATERTANKS (2011). *Closed Top Cone Bottom Tanks & Stands*. Retrieved November 28, 2011, from http://www.watertanks.com/category/5/

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