2011

Wind for Water: Improving Third World Living Conditions with Renewable Energy

Alex Carli-Dorsey

Sam Friedman

Sandra Garcia-Fine

Nick Kepka Calvetti

Jon Sorrells

Alex Carli-Dorsey
Sam Friedman
Sandra Garcia-Fine
Nick Kepka Calvetti
Jon Sorrells
PLA: Hannah McCallum
Professor Brian Savilonis

Wind for Water

Improving Living Conditions in the Third World

Abstract

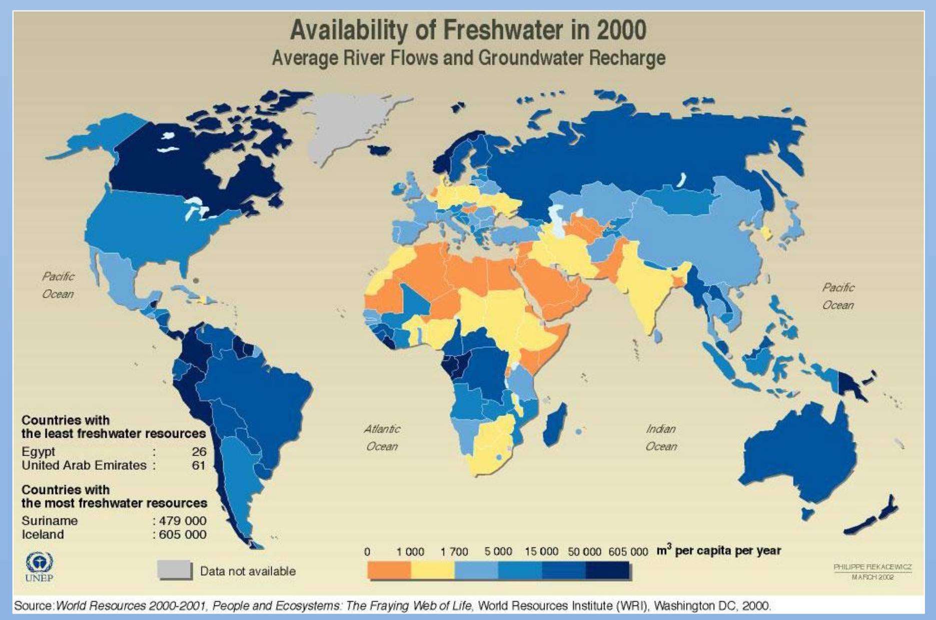
We researched a way to provide water to people in South Sudan. To do this we devised a wind-powered pump system. We found that our system will work in theory, but requires more research and testing before it is put into use.

Project Goals/Objectives

- **Learn how people need and use water in underdeveloped African communities.**
- **Devise a method to bring water to people in need.**
- **Make sure our method is understandable and sustainable.**

Background

The World Health Organization has found that about 3.575 million people die each year due to water-borne illnesses. Many of these illnesses are carried in standing or surface water. Groundwater is consistently cleaner and safer to drink. There have been previous successful attempts to bring groundwater to those in need via wells, though they are often manually powered. We wanted to adapt such a system for wind power since Africa, specifically Sudan, has wind speeds of a magnitude great enough to provide the required pumping power.



Results/Outcomes

•Previous grant-based projects have successfully implemented wind pumping well systems in Africa.

•In theory, our design produces enough power to pump the water, but real-world efficiencies may reduce our output.

•Vertical axis turbines are easier to understand and repair from the perspective of the end users, though horizontal axis turbines would provide higher efficiencies.

Conclusions/Recommendations

•Our investigation provides an excellent start towards a final, real-world implementation of this technology.

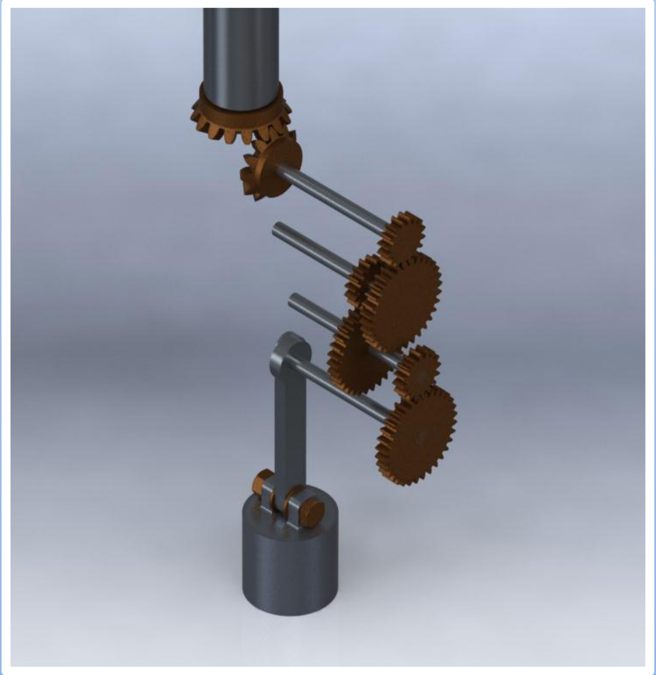
•On-site production would be difficult, so manufacturing would be required.

•More research is required into exact efficiencies and power outputs of our design, requiring at least a scale model.

•An organization should be contacted or formed with the intent to fund and produce this technology en masse for any and all needy communities.

Design Renders

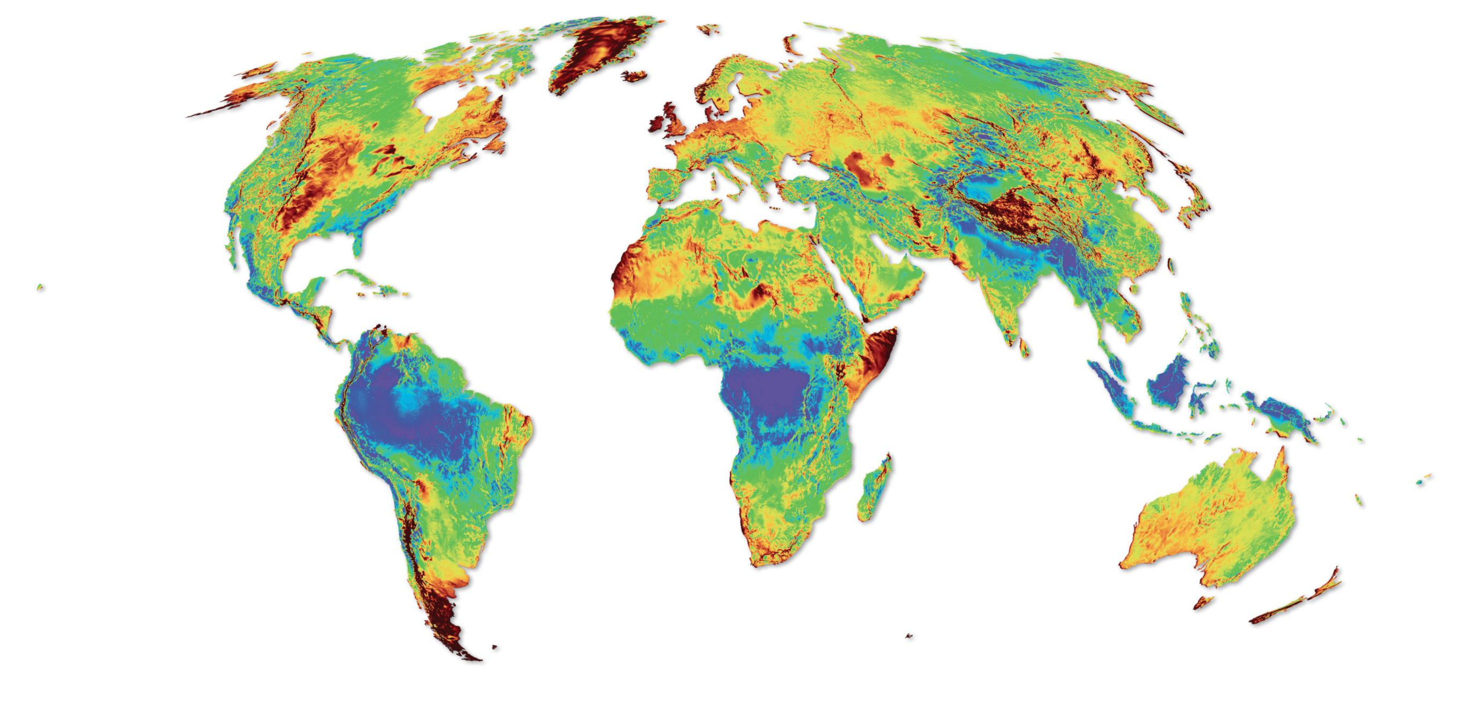
Full turbine pump assembly.



Detail view of gear and pump assembly.

Methodology

- Our pump is a basic piston pump which operates using rotating action from the turbine, pulling water through two one-way valves at each stroke.
- Our pump's required power for 80feet of head at two gallons per minute is 0.04 horsepower. Based on similar pump designs, we can expect a pump efficiency of around 85%.
- The turbine steps up its torque through a series of 1:2 gears three times before it reaches the pump cam.
- Our turbine under wind speeds of 5m/s will output 0.055 horsepower, which is enough to power the pump given its hypothetical efficiency.



Global Wind Speeds at 80m (3tier, Inc)

References and Acknowledgments

http://www.3tier.com/static/ttcms/us/images/support/maps/3tier_5km_global_wind_speed.pdf
White, Frank M. Fluid Dynamics 4th Ed. 2010
http://wwwwds.worldbank.org/servlet/WDSContentServer/WDSP/IB/1999/09/30/000178830_9810190413462/Rendered/PDF/multi_page.pdf
http://www.american-manufacturing.com/files/parts-books/american-manufacturing-aw1122bcd-parts-book.pdf
http://www.mcnallyinstitute.com/06-html/6-01.html
http://www.bdix.net/sdnbd_org/world_env_day/2003/water_year/image/13-freshwater-availabil.jpg

Thanks also to Professor Fiona Levey for her interview.