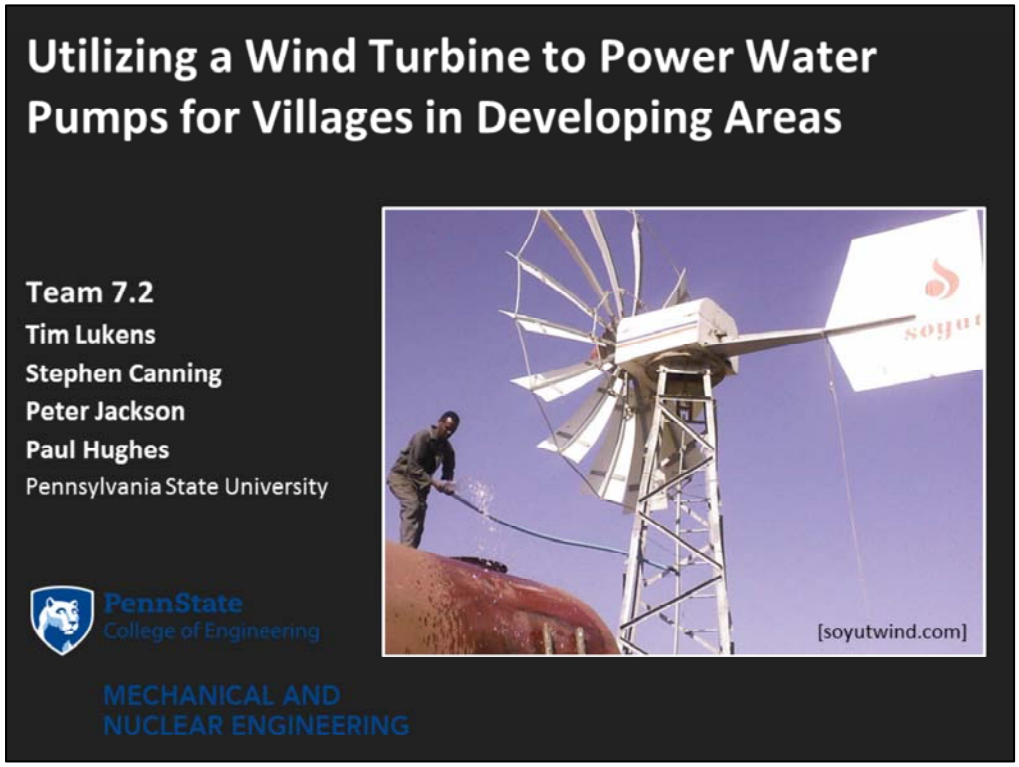


Introduction

Imagine travelling from Hammond building to the Wal-Mart on North Atherton street to buy a 35-pack of bottled water. Now, how many of you, by show of hands, would be willing to walk both ways to get this water?

My name is Tim Lukens and these are my colleagues: Stephen Canning, Peter Jackson, and Paul Hughes. The reason I asked you that question is because many people across the world have to make a several mile trek to gather fresh water.

Transition

Today, we are going to talk about how a small scale wind turbine can be applied to power water pumps in order to transport fresh water to developing areas.

Sources

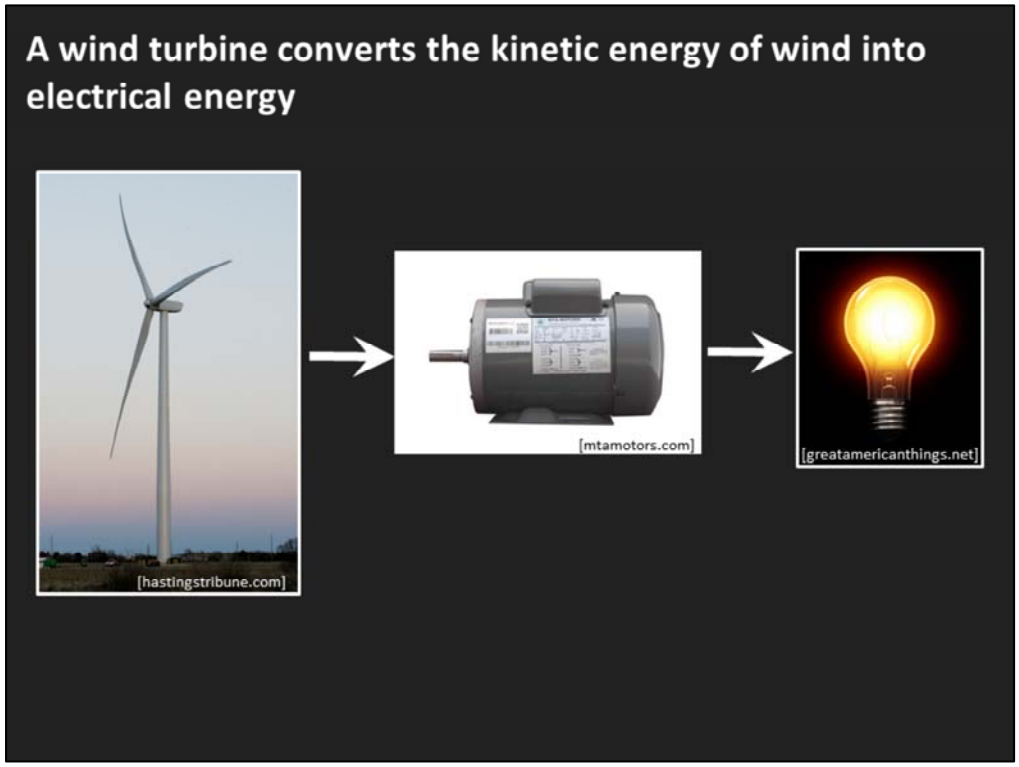
Image: http://soyutwind.com/afrikada-ki-kurulumlarimiz-basariyla-tamamlandi/

Mapping of Presentation

This presentation will focus on four primary topics. First, Tim will discuss the definition, advantages, and disadvantages of wind turbines. Stephen will then talk about the engineering behind how a wind turbine operates and generates electricity. Peter will then take over and explain a potential need for a small scale wind turbine in developing areas. To close, Paul will discuss our team's intended application to satisfy said need.

Transition

First, Tim will discuss the definition of a generic wind turbine.



Definition of a Wind Turbine

A wind turbine is a machine that converts the kinetic energy of wind into electrical energy. First, wind blows perpendicular to the turbine blades, which causes the blades to rotate. The rotating blades then spin a rotor shaft inside the turbine. Finally, the rotor shaft spins an electrical generator, which then produces electricity.

Large scale turbines are typically located in flat, open, rural areas with high wind speeds [1]. These turbines begin generating power when wind speeds reach about 8 miles per hour, and the maximum power output occurs when wind speeds are about 30 miles per hour. To avoid damaging the turbine, a brake is engaged and the turbine is disabled when wind speeds exceed around 50 miles per hour [2].

Transition

Next, I will discuss the advantages and disadvantages to using wind turbines for electricity generation.

Sources

[1] Office of Energy Efficiency and Renewable Energy
https://energy.gov/eere/wind/how-do-wind-turbines-work
[2] The British Wind Energy Association
https://www.nottingham.ac.uk/renewableenergyproject/documents/windturbinetechnology.pdf
Image 1: http://www.hastingstribune.com/news/ccc-wind-turbine-source-of-energy-education/article_d24471d0-cde1-11e6-b3a9-7bc32c87041c.html
Image 2: https://mtamotors.com/agriculture-motors/
Image 3: http://www.greatamericanthings.net/americana/the-incandescent-light-bulb/

Advantages and Disadvantages of Wind Power

The advantages to using wind power for energy generation are as follows [1]:

1. Wind energy is completely renewable and inexhaustible
2. Once a turbine or turbine farm is established, operating and maintenance costs are low due to the simplicity of the machine itself
3. Wind energy does not produce any pollutants

The disadvantages of power generation by wind turbines are listed below [1]:

1. Because most turbines are located in remote areas, transmission lines must be built to carry produced electricity to populated areas. This results in extra start-up costs
2. Many citizens consider wind turbines to be a form of aesthetic pollution
3. Wind turbines pose a potential threat to flying wildlife

Transition

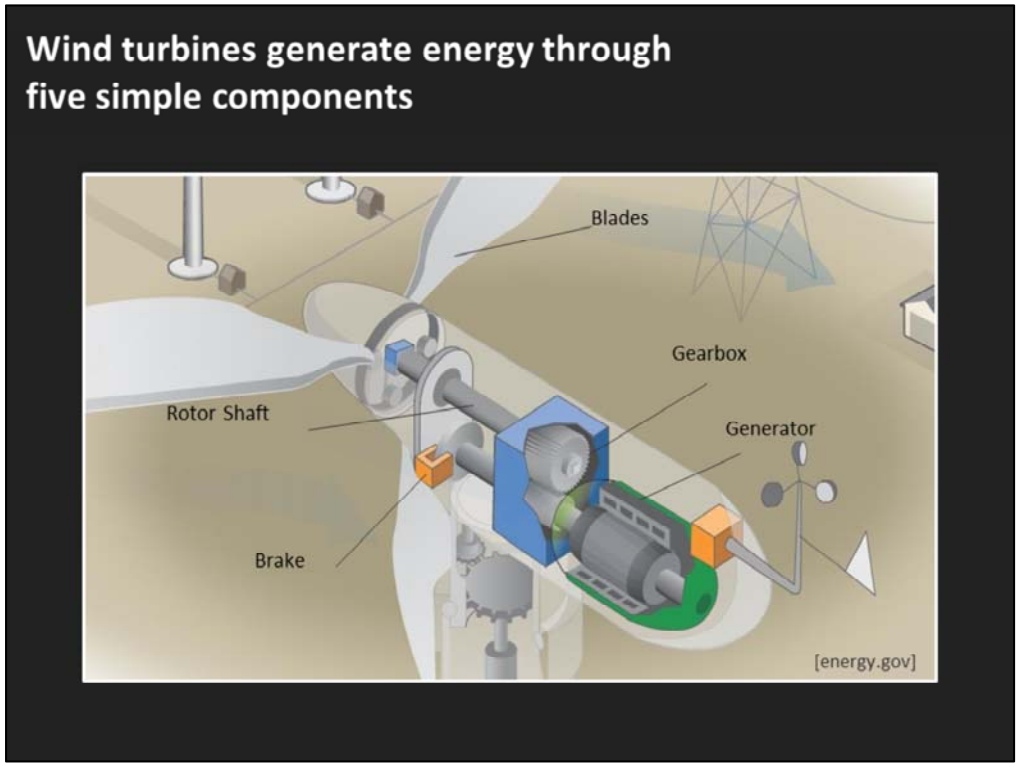
Although the overarching steps by which wind turbines produce power were outlined, there are several smaller components of the wind turbine that make power generation possible. I will now hand it off to Stephen, who will discuss this further.

Sources

[1] Office of Energy Efficiency and Renewable Energy, https://energy.gov/eere/wind/how-do-wind-turbines-work

Image 1: http://www.sciencefocus.com/qa/could-you-fit-solar-panels-wind-turbine-blades

Image 2: https://ww2.kqed.org/quest/2013/08/21/wind-energy-and-wildlife-nebraska-strives-for-coexistence/



Wind Turbine Operation

The major components of a traditional wind turbine include the blades, rotary shaft, gearbox, generator, and the brake.

The blades are designed similar to the airfoil structure of airplane wings, with a round top and flat bottom. This design is used to produce lift, which rotates the blades, and in turn rotates the rotor shaft. This circular motion is what is needed to power the generator. However, the rotor shaft typically spins at only 30 to 60 revolutions per minute (rpm). For the generator to produce signifcant power, it must be spun between 1000 and 1800 rpm. For that reason, a gearbox ia needed. Through the use of gears with different radii, the gearbox is able to convert the 30 to 60 rpm of the rotor shaft into the 1000 to 1800 rpm required for power generation. Finally, the break is used in emergency scenarios or high wind speeds to slow down or stop the rotation of the turbine [3].

For our small scale turbine, we will be utilizing the blades, rotor shaft, gearbox, and a motor to be used as a generator. To reduce cost and production difficulty, additional components such as the yaw drive, yaw motor, and anemometer will not be included.

Transition

Peter will now go over a scenario in which a small wind turbine can positively impact the lives of many people.

Sources

[3] Union of Concerned Scientists
https://www.ucsusa.org/clean-energy/renewable-energy/how-wind-energy-works#bf-toc-3
Image: https://energy.gov/eere/wind/how-do-wind-turbines-work

Potential Need in Developing Areas

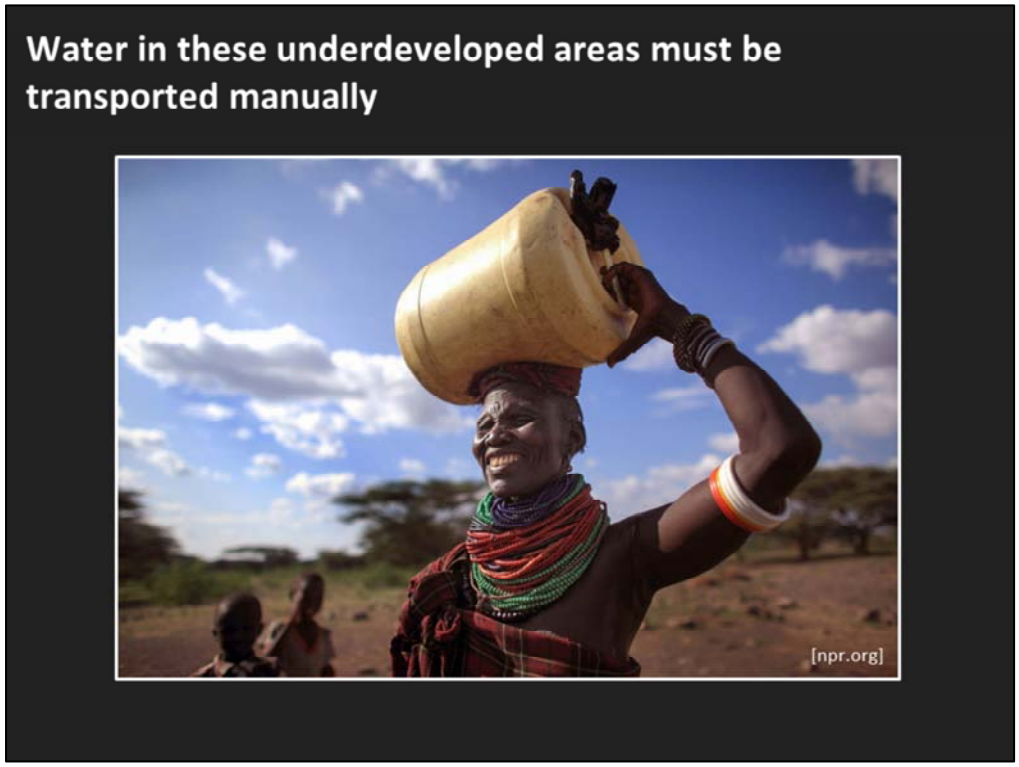
One major issue for people in sub-Saharan Africa is that many do not have access to clean water. For example, according to the United Nations, only 43% of the Togolese population in sub-Saharan Africa have access to clean water [4]. Without clean water, the people are susceptible to many water borne diseases. Since clean water is so scarce in these underdeveloped areas, poor hygiene and health issues arise. The small amount of clean water they can obtain is not wasted on bathing or toilet systems. The poor hygenie resulting from this lack of clean water can lead to dysentery.

Transition

The lack of access to clean water is very taxing on peoples' health and general well being.

Sources

[4] United Nations, Togo: Water, Hygiene and Sanitation
https://www.unicef.org/wcaro/WCARO_Niger_Factsht_WASH.pdf
Image: http://all-about-water-filters.com/facts-about-water-in-africa/



Risk to Citizens without Clean Water Access

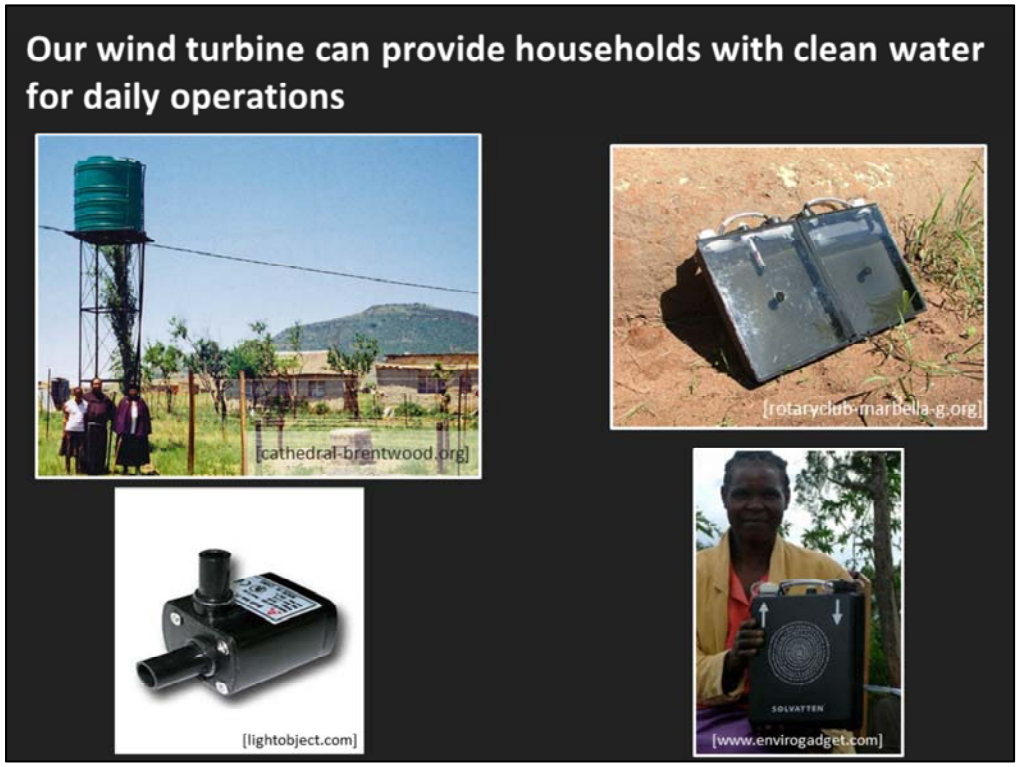
In sub-Saharan African villages, many people are forced to obtain water by walking to fresh water sources and manually collecting it. Even those that are located near a body of water face an issue: this water is often not safe to use. According to the United Nations, 25% of the Togolese population does not have a clean water source within less than a 30 minute walk [4]. A trip of this length is generally only done once a day because it takes so much time and effort. Therefore, large volumes of water must be transported at one time, increasing the physical hardship of collecting water. According to NPR, great societal inequality exists in sub-Saharan African villages, which leaves the task of collecting water up to women and children [5]. Transporting such large volumes of water is very taxing on these peoples' bodies. Providing clean water directly to individuals' houses without physical labor would end these long, difficult journeys as well as improve the overall health of these villages.

Transition

Now, I will hand it off to Paul. He will detail how we can utilize a small wind turbine to provide people in sub-Saharan Africa with clean water to improve their quality of life.

Sources

[4] United Nations, Togo: Water, Hygiene and Sanitation
https://www.unicef.org/wcaro/WCARO_Niger_Factsht_WASH.pdf
[5] NPR, "Millions of Women Take a Long Walk,"
https://www.npr.org/sections/goatsandsoda/2016/07/07/484793736/millions-of-women-take-a-long-walk-with-a-40-pound-water-can
Image: https://www.npr.org/sections/goatsandsoda/2016/07/07/484793736/millions-of-women-take-a-long-walk-with-a-40-pound-water-can



Application in Developing Areas

According to the World Health Organization, between 50 and 100 liters of water per person per day are needed to ensure that the most basic human needs are met and few health concerns arise [6]. Despite this daily need, the average person in sub-Saharan Africa has access to about 20 liters of water per day, most of which is not clean for them to consume. Our household wind turbine and water pump will help provide people who live near water sources with a sufficient amount of clean, usable water. The pump will be connected to Solvatten solar sterilization jugs. When filled, these jugs will collect UV rays from sunlight to kill harmful bacteria and microorganisms in the water [7].

Transition

Now we will delve into the technology required to implement this application.

Sources

[6] United Nations: “The Right to Water” No. 35
http://www.ohchr.org/Documents/Publications/FactSheet35en.pdf
[7] Solvatten
https://solvatten.org
Image 1: http://www.cathedral-brentwood.org/m-maria-r.html
Image 2: http://www.rotaryclub-marbella-g.org/content/mutomo-water-project
Image 3: http://www.lightobject.com/WaterOil-Pump-C43.aspx
Image 4: https://www.envirogadget.com/solar-powered/solvatten-solar-powered-water-purifier/

Low power water pumps have a range of applicable abilities

Voltage	4.5 - 12V	7V
Amperage	50 - 200 mA	110mA
Wattage	.25 - 2.4W	.8W
Max Head	2.5 - 3 ft	N/A
Flow Rate	35 - 45 gal/hr	42 gal/hr

[amazon.com]

[amazon.com]

Water Pump Technology

Our wind turbine will be able to produce about 1 watt of energy. Shown above is the water pump we intend to pair with the turbine. This pump requires less than 1 watt to operate and is capable of pumping 170 liters of water per hour at full power [8]. Due to the unreliability of wind power, we will not be able to pump that much water consistently. However, throughout the day and night, the pump will transport over 50 liters of water for daily use. At maximum efficiencies, our generator produces 12 volts of electricity [8], but our pump requires 7 volts [9]. We will utilize a step down converter when the voltage from the generator exceeds 7 volts to keep our system operating at maximum efficiency.

Transition

Our wind turbine, combined with the water pump shown above, will improve the lives of the people in sub-Saharan Africa.

Sources

[8] Amazon
https://www.amazon.com/Generic-Solar-Power-Garden-Fountain/dp/B007SKGSU6
[9] JameCo Electronics
https://www.jameco.com/RF-370CA-15370
Image: https://www.amazon.com/Generic-Solar-Power-Garden-Fountain/dp/B007SKGSU6

Conclusion

Today, our team talked about utilizing a small scale wind turbine to power a water pump to improve the lives of those in developing areas. To start, Tim defined a general wind turbine and explained some advantages and disadvantages to using wind power. After that, Stephen took over and explained in more detail how a turbine operates and produces electricity. Peter then talked about the need for clean water access in developing areas in sub-Saharan Africa. To close, Paul discussed how water pumps powered by a small scale wind turbine can give these developing areas access to clean water. Thank you very much for your time.

Opening of Floor for Questions