

# Two Efficient Ways to Generate Electricity

By: Aysha Javed

8 Kerr

# Purpose

From the two simplest methods of creating electricity, Hydroelectricity or Wind Power, which is more efficient?



# Hypothesis

If we use Hydroelectricity then it will be more efficient because it generates electricity faster, and creates less noise pollution compared to the sound of wind power.

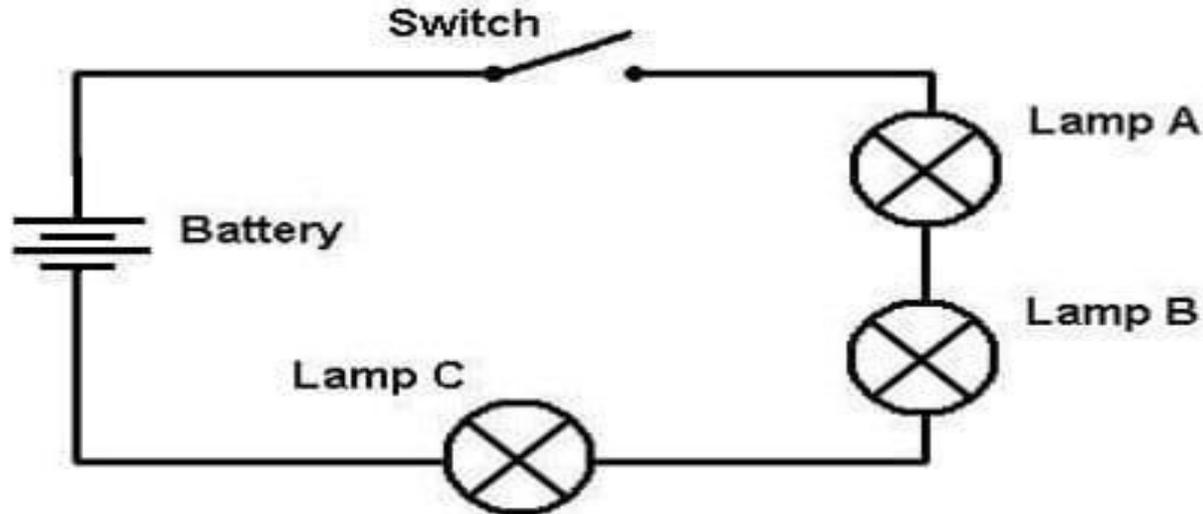


# Variables

**Independent Variable:** The materials used

**Dependant Variable:** The type of solution I used to make electricity

**Controlled Variable:** The type of solution and materials I used



# Materials

Note: This project is research based,  
however I made a model for further explanations

- Gear Box Kit

- a. Pulleys (different sized)
- b. Rubber bands
- c. Holder
- d. Generator
- e. Screws

- Rod

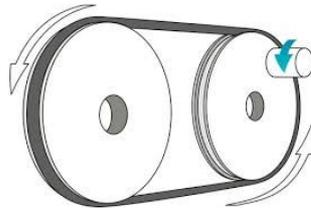
- Blades

- Pulley

- Alligator clips

- Turbine

- Stand



# Definitions

**Hydroelectricity:** The production of electrical power through the use of the gravitational force of falling or flowing water

**Turbine:** a machine made to revolve by fast-moving water, air, or other fluids

**Wind Power:** Power obtained by harnessing the energy of the wind

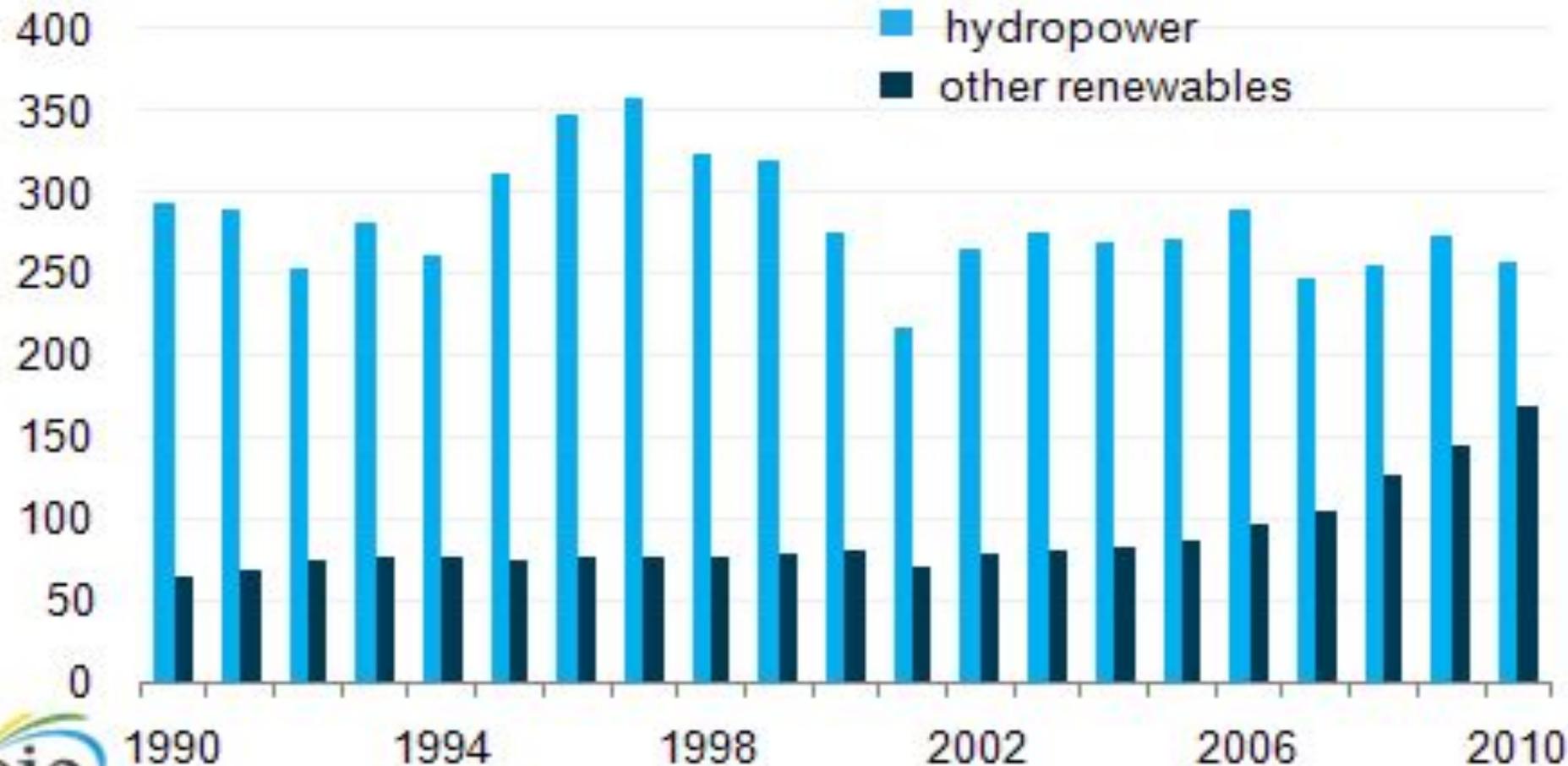


# History of Hydroelectricity

- This useful method of generating electricity has been a part of our humanity for more than 140 years
- Hydroelectric dams and such processes were invented in China around 202 BC-9 AD
- James Francis(American Engineer), in 1849 developed the first ever modern water turbine, the Francis Turbine
- Lester Allan Pelton (American Inventor), in 1870 developed the pelton wheel
- The world's first project using hydroelectricity was used to power a single lamp in 1878
- After many years the first plant was opened in Wisconsin, USA
- Later on during the 19th century different people from Europe and North America invented the types of turbines which we now use for these monuments

# Hydropower and other renewable electricity generation, 1990-2010

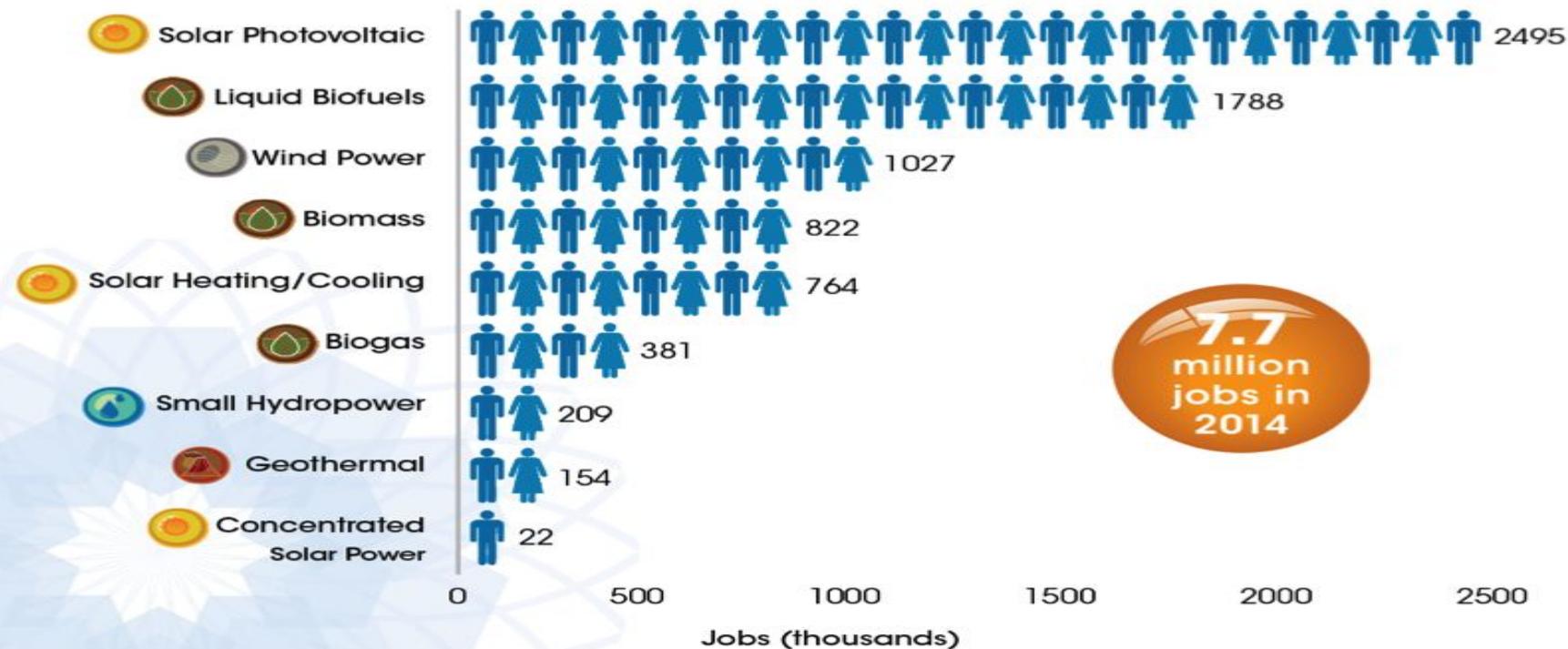
million megawatthours



# Hydroelectricity Facts and Statistics

- The electricity made when water (H<sub>2</sub>O) moves
- H<sub>2</sub>O is the basic formula for water which is a combination of 2 atoms of hydrogen and 1 atom of oxygen
- Usually built in places where there are many bodies of water, or where water drops at high pressure
- Blocks rivers and reservoirs to provide us with electricity so we can use our everyday essentials
- In Canada dams would be in places like British Columbia and Ontario
- In the world dams could be in places like Brazil, China and Russia, etc.
- Due to China's fast growing economy it has the largest dam in the world
- Hydroelectricity can save up to \$125 billion for Canada
- There are approximately 2,300 dams in the whole world

### RENEWABLE ENERGY EMPLOYMENT BY TECHNOLOGY



# Pros and Cons of Hydroelectricity

## 1. Advantages

- Hydroelectricity does not use the water in a way because the water is returned to that same body of water
- Hydroelectric power can be made anytime if there is water
- It is also environmentally friendly thus there are no emissions released
- There is a gate at the beginning of this process which can control the amount of water that enters
- Also very beneficial when there is a flood; it can be used as flood control

## 2. Disadvantages

- A lengthy process to build a dam and requires a high quality
- A dam must survive for at least a decade to make up for the money used to make it
- In some cases hydroelectricity can cause the death of animals or loss of habitat
- The creation of a dam can lead to the destruction of a recreational area
- The water is very loud, since it drops at with a lot of pressure

# Finance and Efficiency of Hydroelectricity

- In Canada, the main source of Hydroelectricity is from Niagara Falls, however it only provides electricity to that general area
- Hydropower is produced for an average of 0.85 cents per kilowatt-hour (kwh)
- Hydroelectricity is usually cheaper than nuclear, because it is free once it's built
- Modern Hydro Turbines can convert up to 90% of the energy into electricity and the best fossil fuel energy are only about 50% efficient.



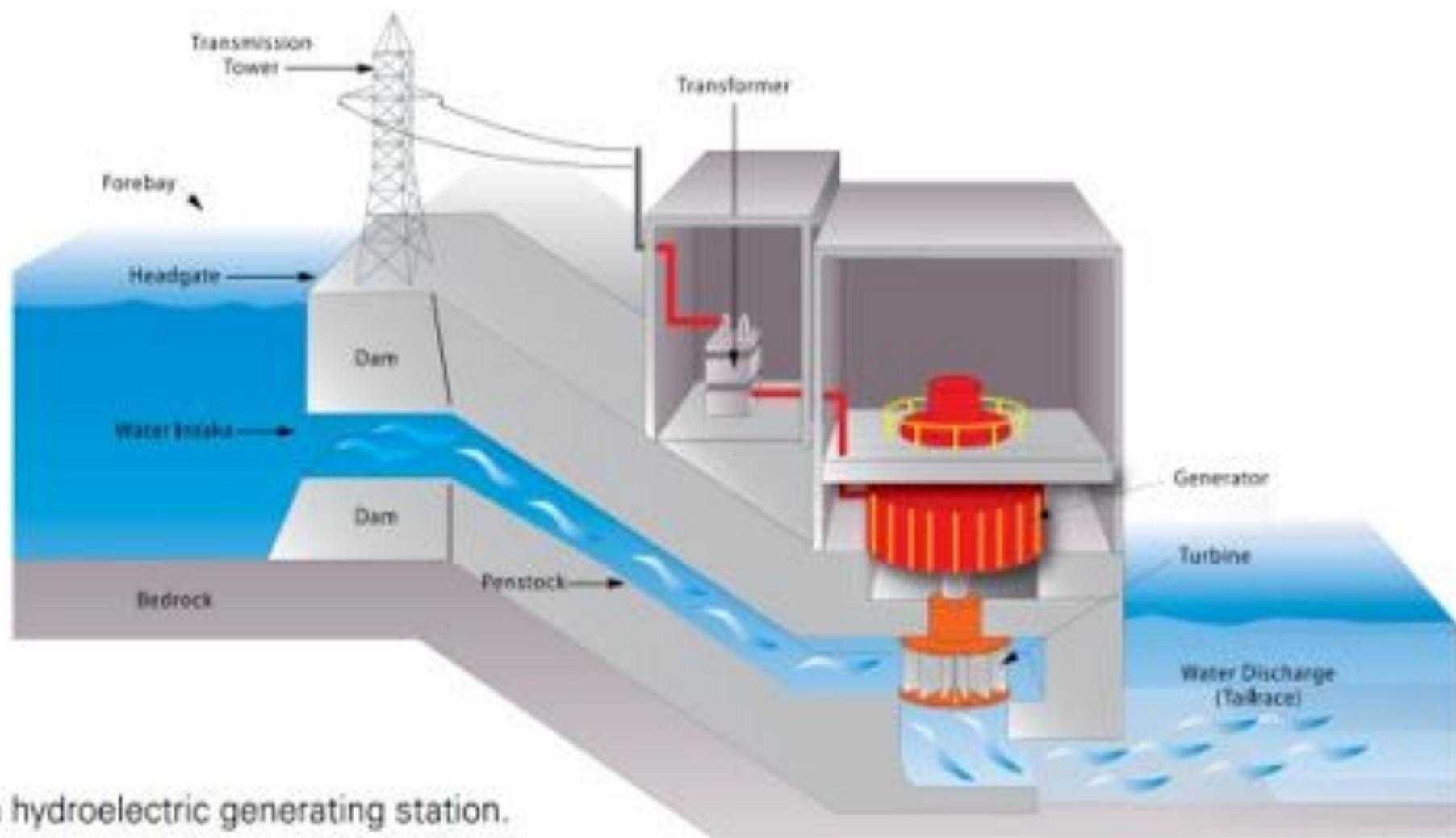
# Hydroelectricity

- **How electricity is produced?**

Water runs down the penstock increasing the speed and pressure of the water. The water will hit the turbine causing it to spin. With an axle to the generator which then turns potential energy into electrical energy thus, creating electricity. Before creating this electricity it is taken to the transformer so it can actually be able to run daily life supplies. The transformer is attached to the transmission lines to carry the electricity to places where it is needed. Then the water is returned back to the original place it was in.

- **Does it create more electricity than other ways?**

No, this is not the most efficient type of electricity. It is proven by electricians and specialists that wind is the most efficient and creates the most energy the fastest. Hydroelectricity is definitely slower than wind because it has to get the right amount of water to close the door. This is the long part otherwise both would be about the same time.



of a hydroelectric generating station.

# Hydroelectricity

## **Small-Scale:**

- Usually 10 MW or less in size
- Is a renewable electrical energy source
- Non polluting; no heat and noxious gaseous release
- Inflation proof and there is no fuel cost
- Provides reliable and flexible operations
- the stations for hydroelectricity have a long life
- The hydro power stations are 90% achieved of making the most efficient conversion technologies

## **Large-Scale**

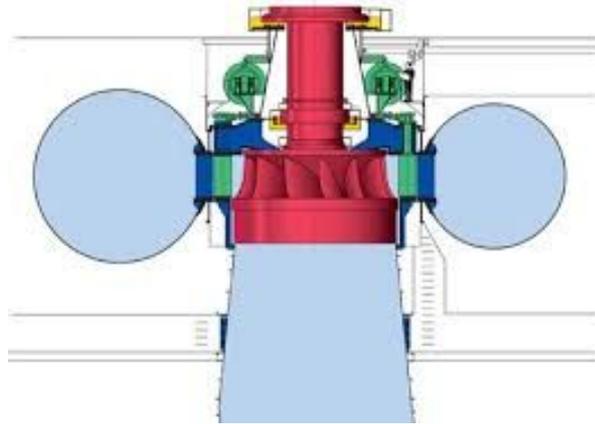
- A form of renewable energy generation derived from flowing water used to drive large water turbines
- Cost a lot although they have low maintenance costs and can last over 100 years
- The water can be stored above dams so it may be used when needed to produce power

# Turbines

**Pelton Turbine**

**Francis Turbine**

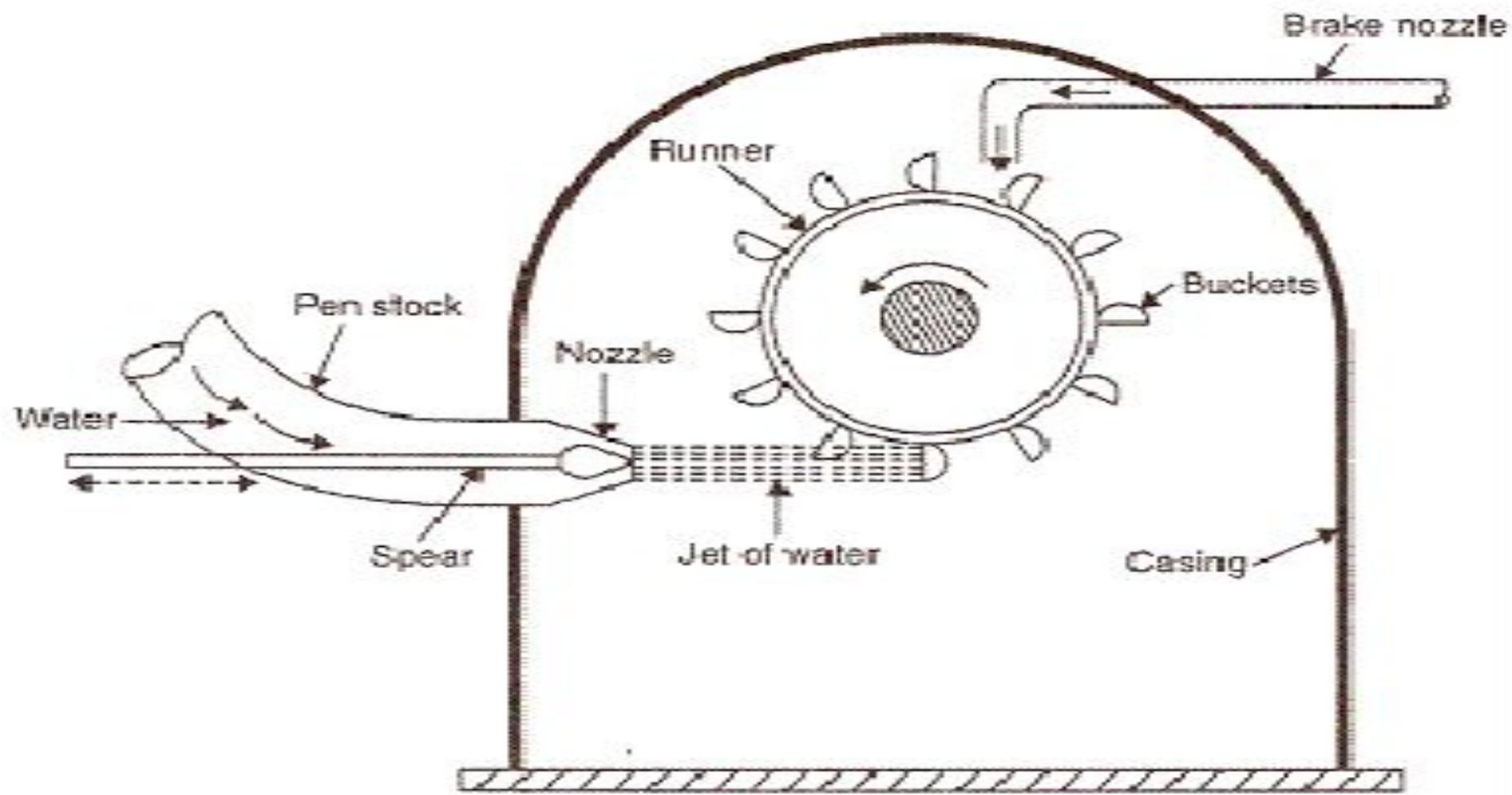
**Kaplan Turbine**



# Pelton Turbine

- Much smaller than Francis Turbines
- 4 ft in diameter and can weigh up to more than 15 tons
- Most durable and cost efficient and can reach up to 500 rpm
- The name Pelton came from the engineer named Lester Pelton
- Has cup-like objects to help the force of water
- Most efficient out of the three turbines and can reach an efficiency of 95%
- For this type of turbine, the more water the better
- Due to its parts it is easier to vary the size of the wheel
- The best way for this turbine to work is having a jet-like water flow
- The spear at the end of the penstock gives the water more pressure

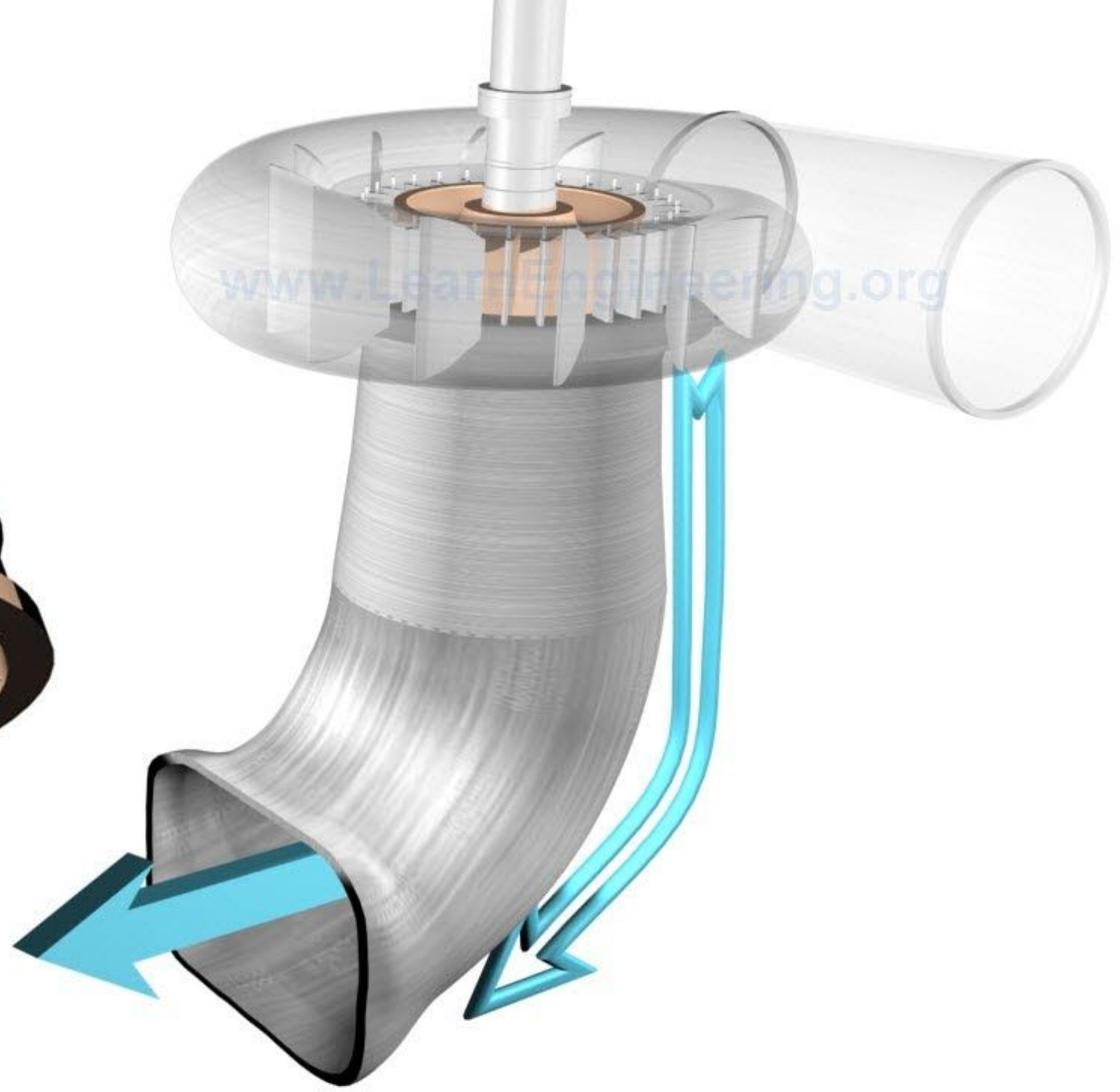
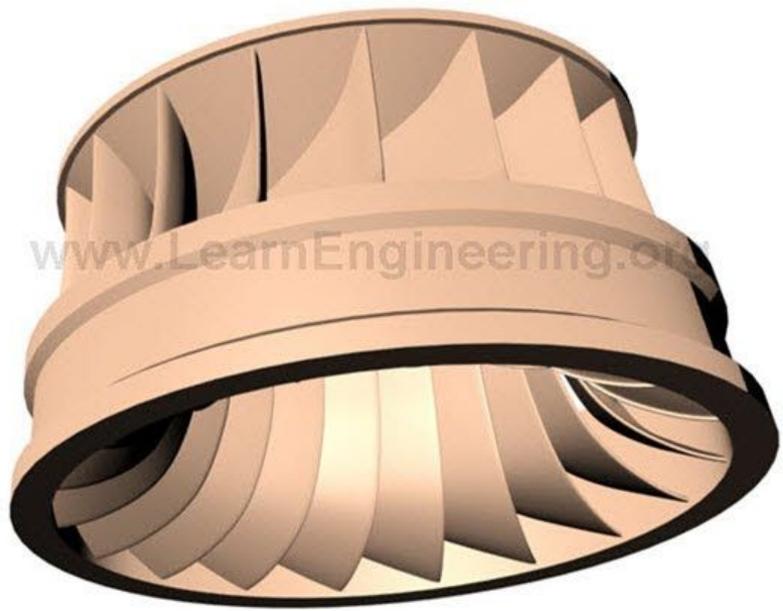
Penstock, nozzle (high speed), buckets, runner (rotating water), casing (protection),  
Breaking jet (stops wheel)



# Francis Turbine

- The most common turbine used today
- Installation is cheap, the cost is about \$5,000
- Their blades are designed in a way to make it more effective
- The name Francis came from Jame Francis (engineer) who also designed this turbine
- They are also most wanted in today
- Has an efficiency of 90%
- Unlike other turbines this type is able to give more efficiency towards making the energy
- Has a diameter of 10 feet and weighs about 420 tons
- These machines are very reluctant and can take various pressures and other mechanical stress

Spiral casing (keeps everything in order), guide (guides water), stay vanes (stationary)  
Runner blades (rotate), draft tubes (bring water)



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# Kaplan Turbine

- The kaplan turbine has adjustable blades to meet the requirement of the flow rate
- Named after the man Viktor Kaplan
- Has the ability to gain efficiency from various flow of water
- Weighs about 17 tons and has a diameter of about 3-5 meters
- Can also reach a 420 rpm
- May reach an efficiency of over 90%
- Costs the most out of all of the turbines and is similar to the Francis turbine
- Have curved blades to maximize the speed
- The vanes controls the flow of water so that the machinery works better

Scroll casing (cross section area), guide vanes (controller), draft tube ( brings water), runner blade (heart/power generator)

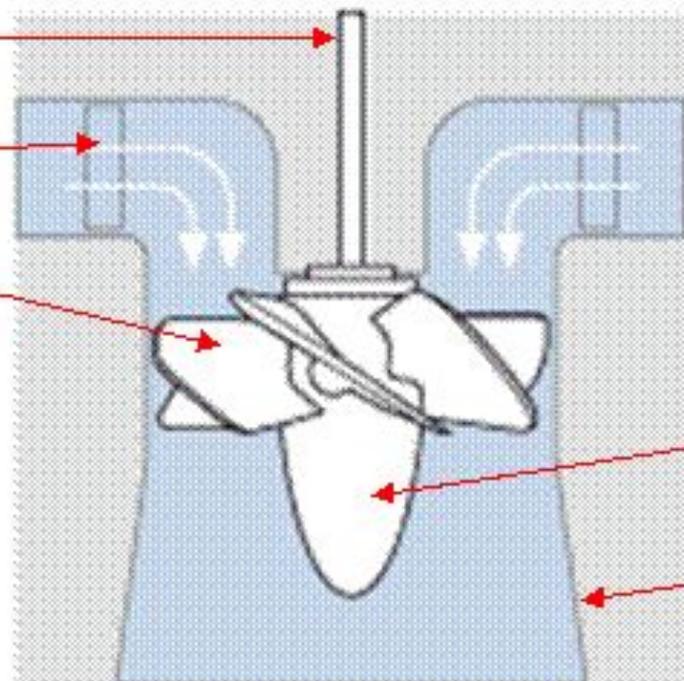
Vertical driveshaft

Inlet guide-vanes

Rotor (adjustable blades)

Nose cone

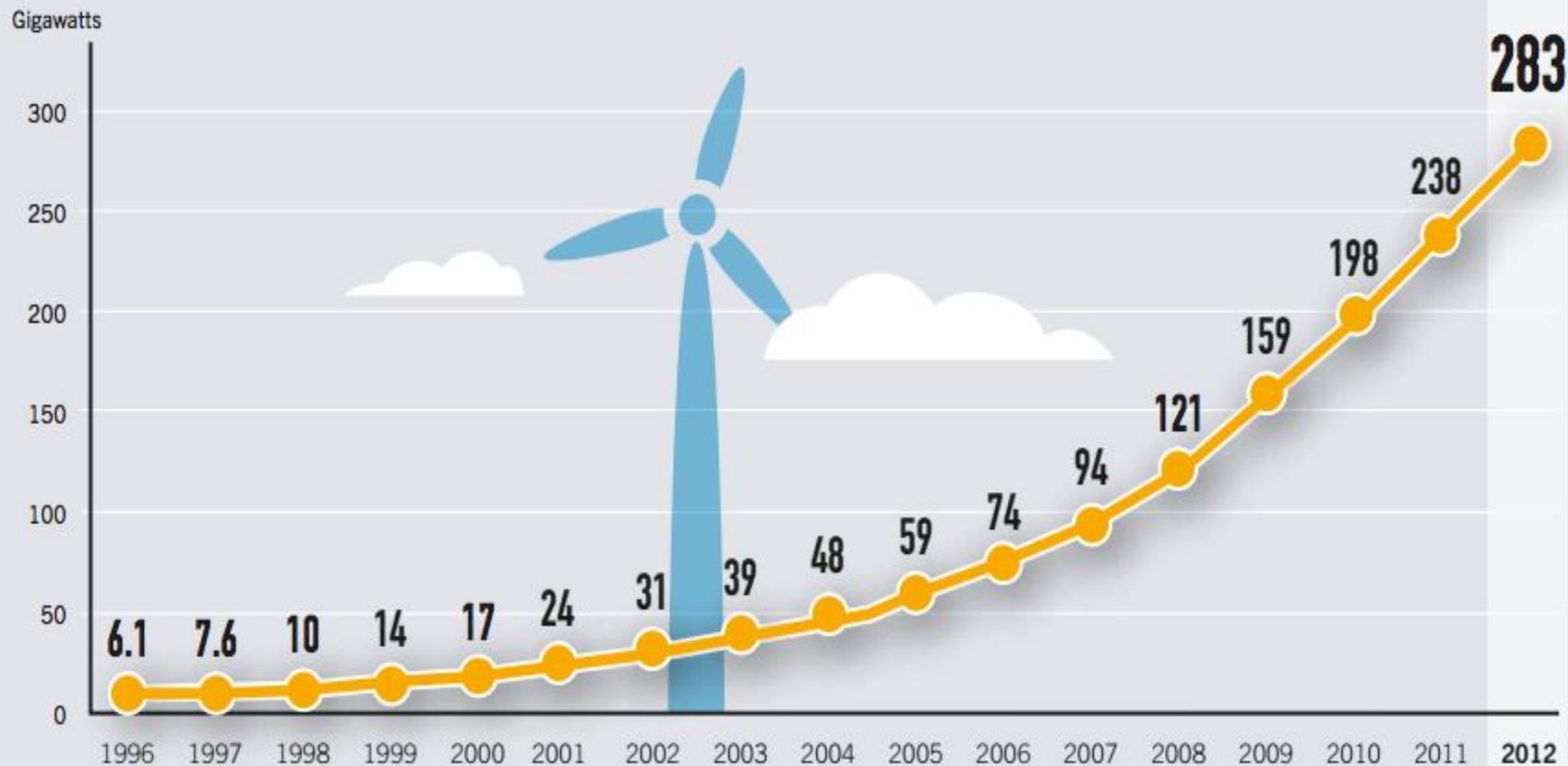
Draft tube



# History Of Wind Power

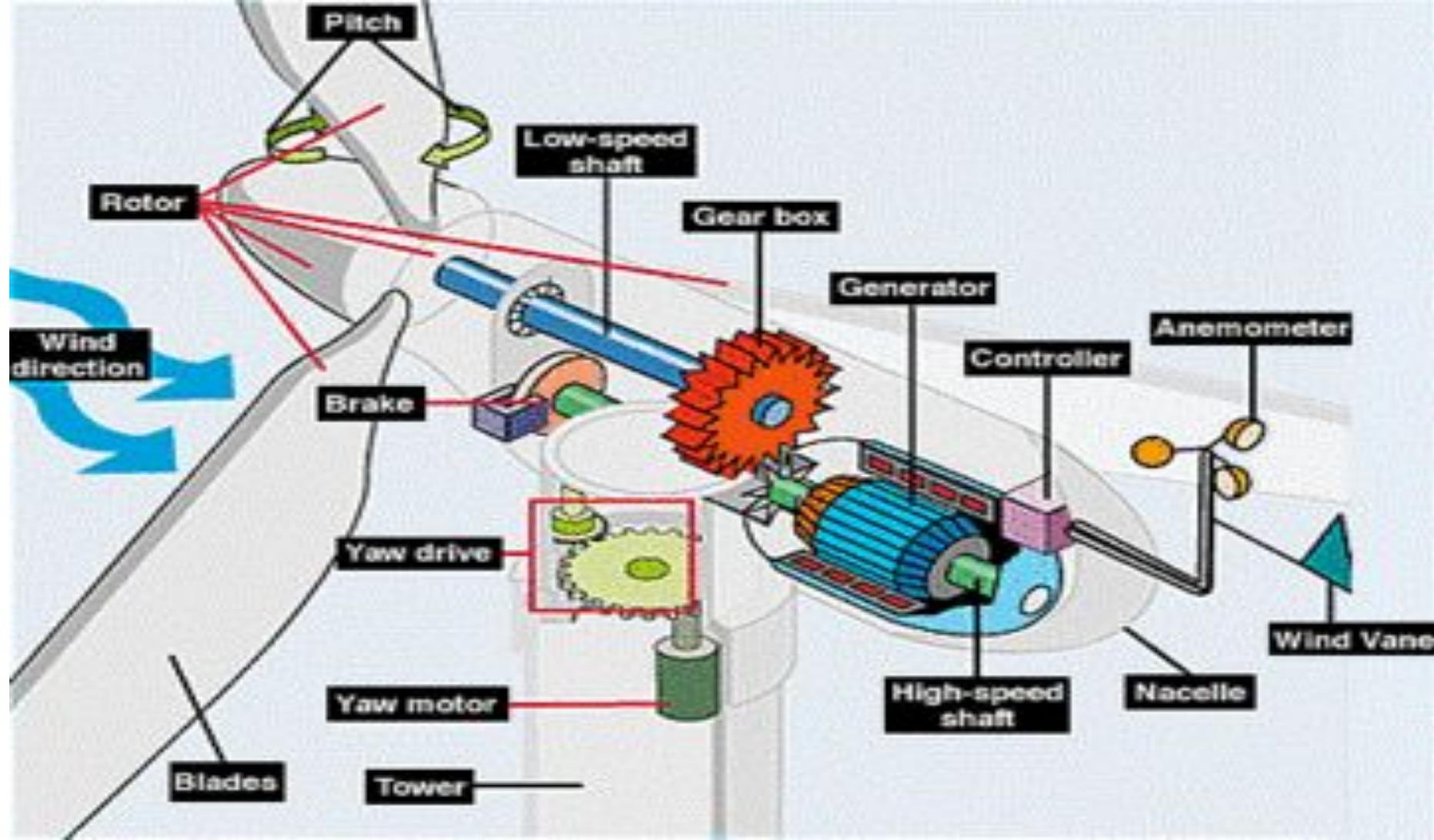
- Charles Brush; for his mansion created the first ever windmill in Ohio.
- Before this times, such procedures weren't invented; it came after the first hydroelectric dam was created and was defined as a success
- Poul la Cour prototype electrical power plant from his windmill, in 1895
- In 1900, many windmills were being used in Denmark for mechanical purposes
- Then in 1903, Poul la Cour started a society of Wind electricians.
- Poul la Cour is known for creating faster spinning turbines that are more efficient with less blades.
- 72 electricity-generating wind power (5 kW - 25 kW in size) were being used in Denmark by 1908
- Joe Jacobs and Marcellus Jacobs opened a factory called "Jacob Wind" which were used to batteries and power lights
- Later on, many experiments were done on turbines to discover the most efficient turbine.

# WIND POWER GLOBAL CAPACITY, 1996–2012



# Wind Power Facts and Statistics

- Is the electricity made when air moves
- Air includes O<sub>2</sub>(oxygen) and CO<sub>2</sub> (carbon dioxide) etc.
- Turbines move causing a great deal of electricity
- made from high wind pressures usually in rural areas and closer to shores
- It's a sustainable source of energy
- The blade is about 200 foot (60 meters) long
- A recent Wind turbine broke the record of energy created. It was closer to the shore and had larger blades
- The production of Wind turbines have increased over 25% per year
- This energy has been the most sufficient from 2011-2020
- Similar to solar energy because it's created by the uneven heat in the earth's atmosphere
- Beneficial in many ways that include: providing energy to businesses, homes and schools. etc.



# Pros and Cons of Wind Power

## 1. Advantages

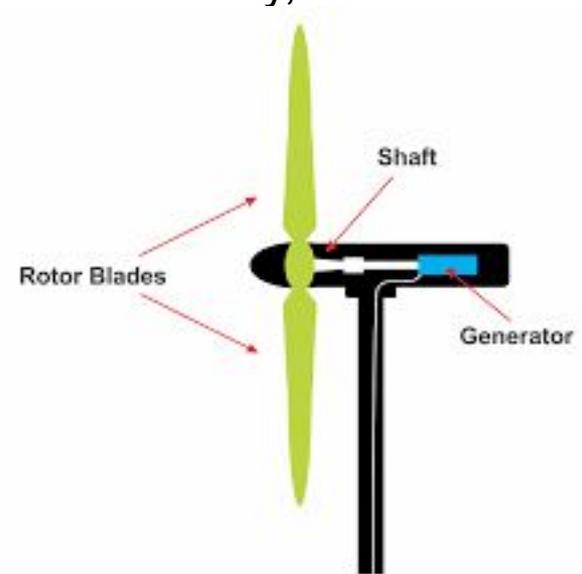
- Wind is free and creates no emissions
- We are now able to use the wind efficiently
- Some are gets covered, however the parts under the turbines can still be used but it's recommended by specialists that 550 meters around the windmill is a prohibited area
- It's a nice landscape
- Wind turbines have a role to play in both the developed and third world
- The larger the blade, the more electricity

## 2. Disadvantages

- The strength of wind can vary from locations which will affect the amount of electricity that is being produced
- Really costly to build
- Extremely noisy; may generate the amount of noise of a car going at 70 mph
- Large wind farms are needed to provide entire communities with enough electricity
- The largest single turbine today can only provide electricity for 475 homes

# Finance and Efficiency of Wind Power

- To install a wind turbine it costs about \$48,000 to \$60,000
- The equipment cost is about \$40,000
- Wind power is produced at an average of 2.5 cents per kilowatt hour
- Wind turbines will generally operate at lower than it's best efficiency, because wind speeds are never constant or average.





1. **Wind** blows...

2. across tall **windmills**...

3. to turn the blades of huge **turbines**...

4. which spin **generators** to create electricity.

5. A **transformer** increases the voltage to send electricity over...

6. **distribution** lines. Then local transformers reduce the voltage...

7. for **you** to use.

# Wind Power

- **How electricity is produced**

The wind blows and moves the blades causing them to rotate. The rotation of the blades makes the turbine move, this also makes potential energy. This energy moves to the generator which promotes it to create electrical energy. Then this energy moves to the transformer; which makes it into electricity and sends it to the power lines. From here the electricity goes to people who need it.

- **Does it create more electricity than other ways**

Yes, Wind power is the most efficient way to transport electricity compared to any type of turbines or Hydroelectricity. This is proven by electricians and specialists, that wind is the most efficient and and creates the most energy conveniently (fastest). Wind turbines are also faster than any type of turbine since wind is free.

# Wind Power

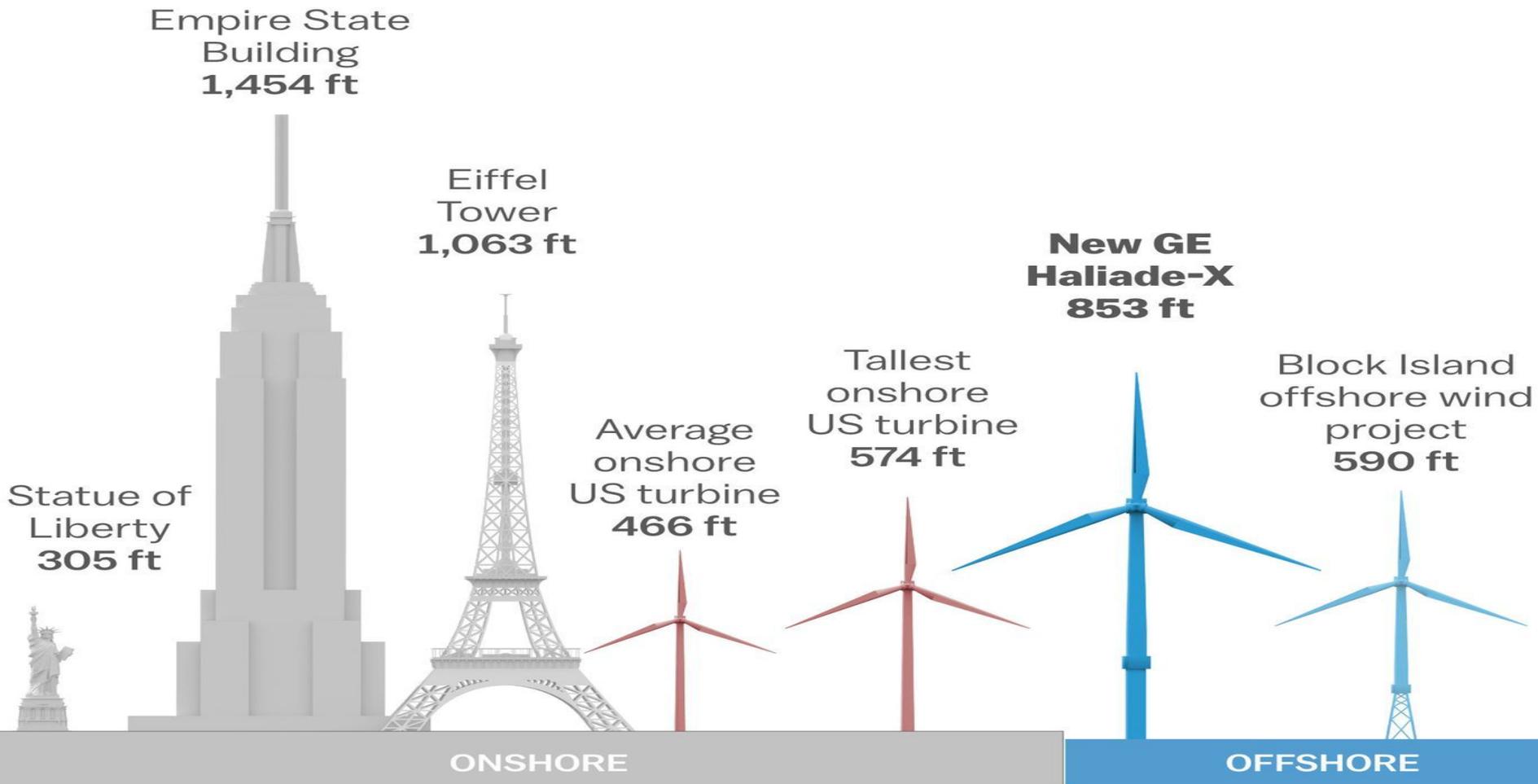
## **Small-Scale:**

- A wind powered plant can vary in sizes, from 9m in height and 3m in diameter can create up to 10kW.
- Due to its size the turbine only generates a small quantity of electricity
- Creates no harmful effect to the environment making it a very useful mechanism
- Usually located at wind farms and can provide electricity to about 600 homes

## **Large-Scale:**

- This machine varies in size, from 220 m in height and 164 m in diameter; it may create up to 8 MW
- The size is beneficial, but also can be disturbing to many organisms on the planet.
- It's size also increases the capacity of making electricity faster in less time
- Other than it's huge wings, it creates no harmful pollutant that can possibly disturb the municipality
- Usually offshore and can provide up to 2,300 homes with electricity

# How the Haliade-X compares



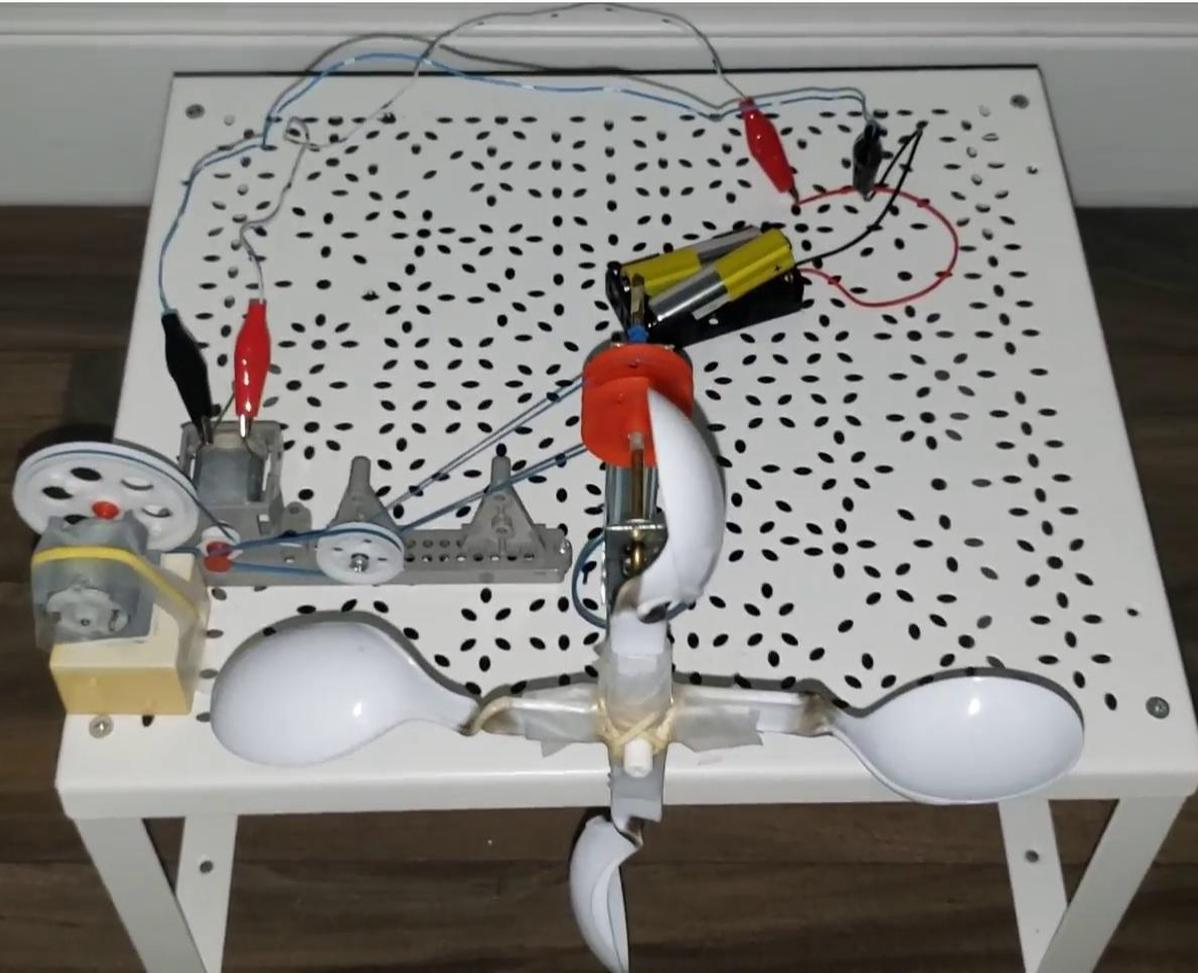
# Observations

I observed that the model/diagram that I made was producing less than a volt of electricity, then I changed up the gears and therefore it created more electricity. I also observed that when you attach a small pulley with a large one, then it will generate more electricity. This is because if the large pulley has one rotation then the smaller pulley will have 3 or 4 rotations. In other words, when big is attached with small, the small one will have a greater rpm and it will create more electricity. Through the research I also observed that Wind Power will be creating more electricity than Hydroelectricity. Wind is also an easier process because it doesn't take much effort after being built. I have been to a dam before and it is a very pleasant sight to see and it is very soothing. To wind up (pun intended), many ways to generate electricity are efficient, however the most efficient are Wind and Hydro.

# Conclusion

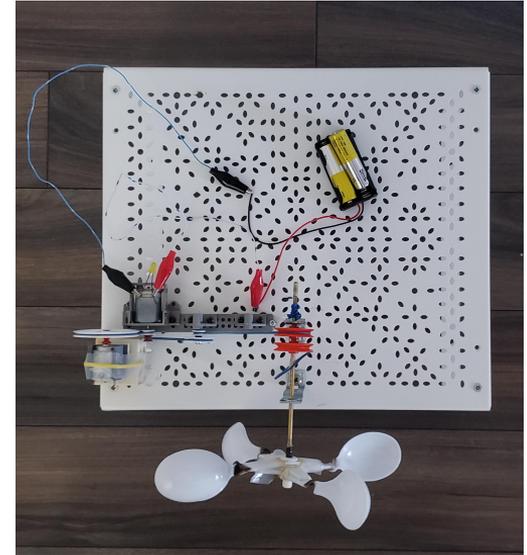
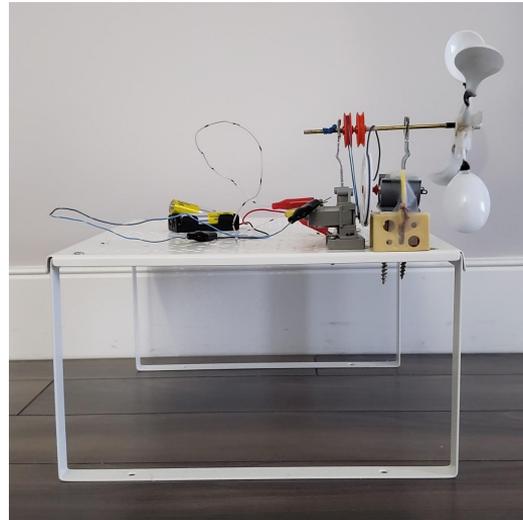
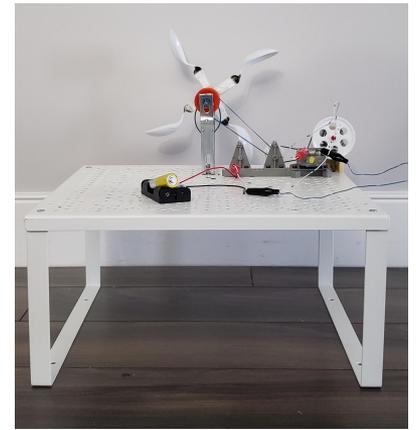
My hypothesis was wrong and there was much I didn't know about. Through all of the research that I have done and what I have learned, I can say that Wind Power is the more efficient source of electricity compared to Hydroelectricity. I really like this project especially making the model to show. It was fun for me and I hope that it was fun for you as well. I am now able to use this knowledge in my further studies in electricity. I want to become an engineer or electrician when I grow up. I was inspired by my uncle in Pakistan, since he is also an electrician. This will also open up new career opportunities for me in the near future. I love doing these types of projects because, they keep me busy and I can learn new things. I really hope you enjoyed. Be sure to look at my turbine model, logbook as well as the references on the next couple of slides!

# Turbine Model Demonstration Video



# Turbine Model Pictures

Note: This project is research based, however I made a model for further understanding



# Logbook

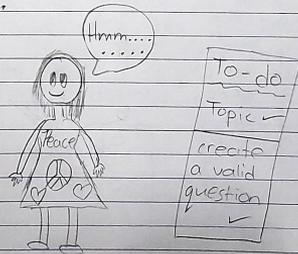
## My logbook! 2020-2021

\* Throught my writings I will talk about the struggles I faced in the time being of my project. I am glad though that I am taking part of the science fair. Every single day I woke up at 8, went to school and used the rest of the time for planning out & doing. But obviously my first priority was homework. This amazing project took me from Jan. 20 to february 7<sup>th</sup>.

even though it was online school

### January 20<sup>th</sup>

Today I gathered my thoughts on a piece of paper for what topic I should do. I soon took some advice from friends and family. After some time I created a long to-do list for the project. Later on I made the question so that I could begin researching.



### Jan. 21<sup>st</sup>

On this day, I began to think about the names of slides and also what pictures I would use throughout the whole thing. Eventually I found some pictures about my renewables. That same day I also made my own hypothesis according to the question.

### Jan 22<sup>nd</sup>

Today I researched about the most common renewables today and found some graphs on it. I soon realized that I should start a references slide so I started to do so.

### Jan 24<sup>th</sup>

Today, I began researching on turbine and started to create a general idea for myself. And then I searched some fun facts about turbines. Also I discovered to use 3 types of turbines throughout. I also defined some terms.

TO-do  
hypothesis  
✓

TO-do  
definitions  
✓

TO-do  
references  
✓

### Jan 25<sup>th</sup>

On this day, I began to research on the 2 renewables I was using. They were hydro electricity and wind power. I researched some advantages and disadvantages of each and jotted which one was more efficient.

### Jan 27<sup>th</sup>

Today I researched about the history of turbines and the history of hydroelectricity. I also began a reference page for my images along with revising the work that was already done.

### Jan 31<sup>st</sup>

On this day I woke up extra early so that I could catch up on the work I missed since I hadn't been working for the last couple of days. I used today to do correcting and fixing some mistakes that I found.

TO-do  
image references  
✓

TO-do  
correcting  
✓

TO-do  
history of turbines  
✓

TO-do  
Review  
✓

# Logbook

Feb 2<sup>nd</sup>

Today I worked on my observations and conclusion. The most exciting part was knowing that I was almost done, even though I love studying science (seriously).

Feb 3<sup>rd</sup>

On this day, I fake presented to my whole family to work on the things that I was doing wrong, then I soon relaxed and took a break from it even though it took me 2 hours in the process.

Feb 4<sup>th</sup>

Today I called some professionals in this industry (or people that know more about this) so I could ask some interview questions.

Feb 7<sup>th</sup>

Today was a confusing day because I didn't know what to do when I was done, since this year Science Fair was online.

| TO-do      | TO-do        | TO-do      | TO-do   |
|------------|--------------|------------|---------|
| conclusion | observations | interviews | finish! |
| ✓          | ✓            | ✓          | ✓       |

## Interviews

Monica Me: How does electricity play an important role in your life?  
University student Monica: Every way including cooking, studying, entertainment and even simple things like light. I need electricity for every step of my life.

Me: Which way of generating electricity do you think is best?

Monica: Windpower since it is cheaper; for a hydro you would have to build a whole dam but for wind power even a small one will work.

Me: Would a design of a turbine make it be more efficient?

Monica: I believe that adding longer blades will make it more efficient since it will have a greater surface area.

Jalal = in electrical engineer Me: How does electricity play an important role in your life?

Jalal: Usually more than I can count especially when you have children like myself.

Me: Which way of generating electricity do you think is best?

Jalal: Oh yeah, wind; efficient and all the work the wind does.

Me: Would a design of a turbine make it more efficient?

Jalal: I would make the design higher so that there is more wind which will cause more electricity.

Irfan Me: How does electricity play an important role in your life?

profession in this field Irfan: It's an important role because I always need my laptop, for social media I would like my hoodie studies.

Me: Which way of generating electricity do you think is best?

Irfan: I think both because Africa has no water and places like Canada like wind, I don't have wind so I think 60% hydro and 40% wind. Not totally sure over the other.

Me: Would a design of a turbine make it more efficient?

Irfan: I would say that if you want to make it more efficient by changing the design then have 3 faster blades so that it could be more aerodynamic. The faster equal more wind coming to push it so, it will go 1 much faster. Think of it this way, the more pressure could it will work harder so it will generate more potential energy or kinetic energy.

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