



# Sustainable Energy in Bridgeport CT

Erika Pinto  
Sabrin Abbe  
Dylan Padua  
Janet Cruz  
Dr. Steffen

# What is Renewable Energy?

---

- Renewable energy is a source of potential energy that can be transformed into electricity without the use of fossil fuels.
- Some examples include solar energy, wind, wood, and hydro energy.



- Fossil fuels are fuels found within a natural environment that emit CO<sub>2</sub> and particulate matter. They are usually made of decomposed animals and plants.
- The most known examples of fossil fuels are Coal, Natural Gas, and Petroleum.
- Improper burning releases NO<sub>x</sub>, CO, SO<sub>2</sub>, and Ozone into the atmosphere

# What is Climate Change?

- Due to the amount of CO<sub>2</sub> released into the atmosphere, there has been a noticeable change in the planet's temperature.
- On average, the global temperature has increased by about 1.4-degrees Fahrenheit over the past 100 year.
- Some of the most noticeable damages of climate change are the melting of ice sheets and glaciers which contributed to the rise of sea level, ocean acidification, ecological impacts, wildfires, floods, heat waves, and droughts.
- 97% of Climate scientists today support the idea that climate change is happening- and it effecting our environment



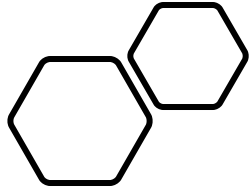
# How do we measure electrical energy?

- When measuring power, there are 3 units: **Voltage, Amperage, and Watts.**

But what exactly are they...?

- **Voltage** is the speed of which the electrons pass within the circuit.
- **Amperage** is the unit that measures the volume of the electrons within a current
- **Watts** is the method of measuring the rate of energy transfer. Energy over time
  - On average, a house uses 30kW a day





- Where did we go?



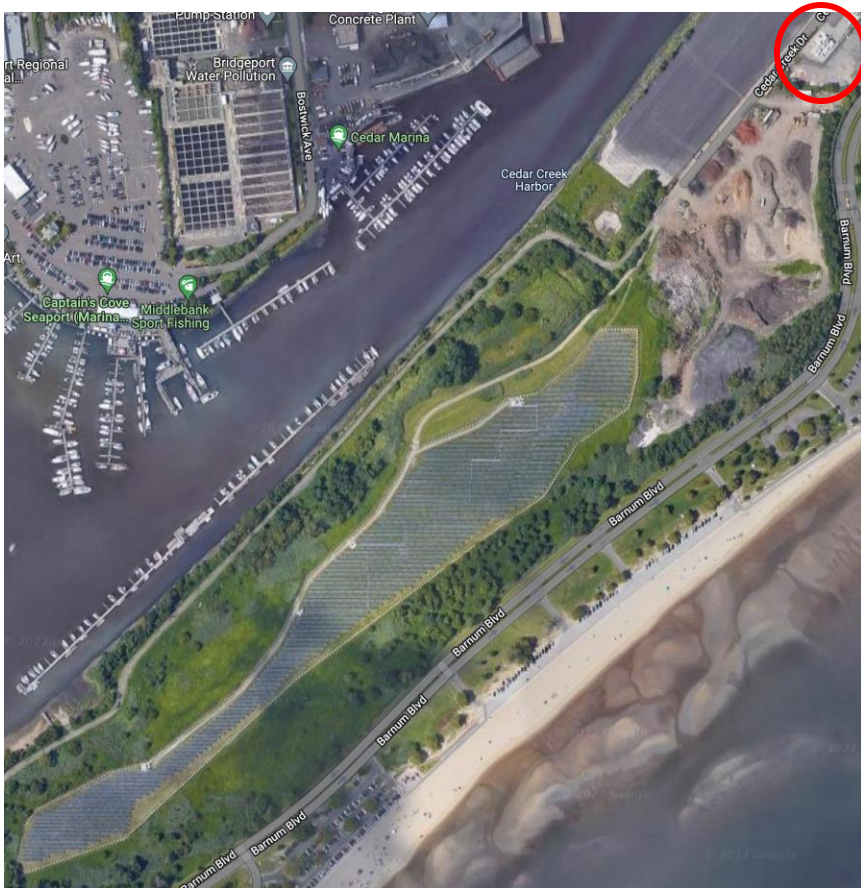


# Connecticut Energy Plants

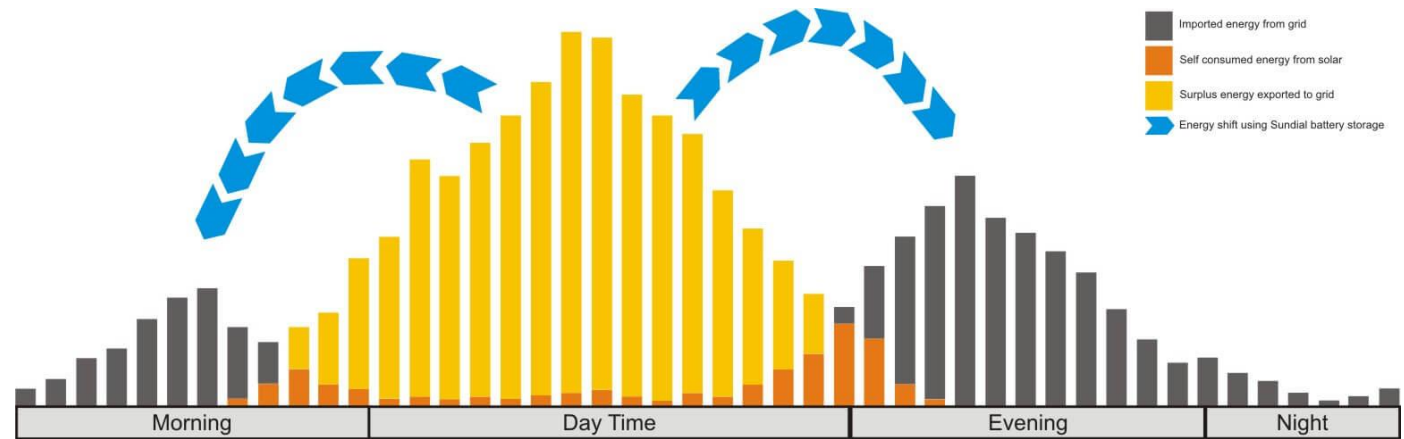
- Fuel Cell Power plant – 14.9MW
- Win Waste Energy Incinerator – 68MW
- Seaside Solar Farm – 2.5MW
- Fairfield University Powerplant – 4.5MW ~90% Fairfield U power
- Millstone Nuclear Power Plant – 2098MW ~50% of CT power







# Renewable Energy Challenges



- Renewable energies aren't as energy dense as a natural gas or nuclear powerplant
- Solar Power Maintenance costs more than fuel cell maintenance.
- NIMBY (Not in my Backyard) movements to preserve housing value reduce the possibility of solar powerplants.
- Solar Power only works when there is Solar Energy (Sun). During the winter and nighttime there is little to no power being produced.

# Two growing and useful forms of renewable energy

- Solar Power
- Wind Power





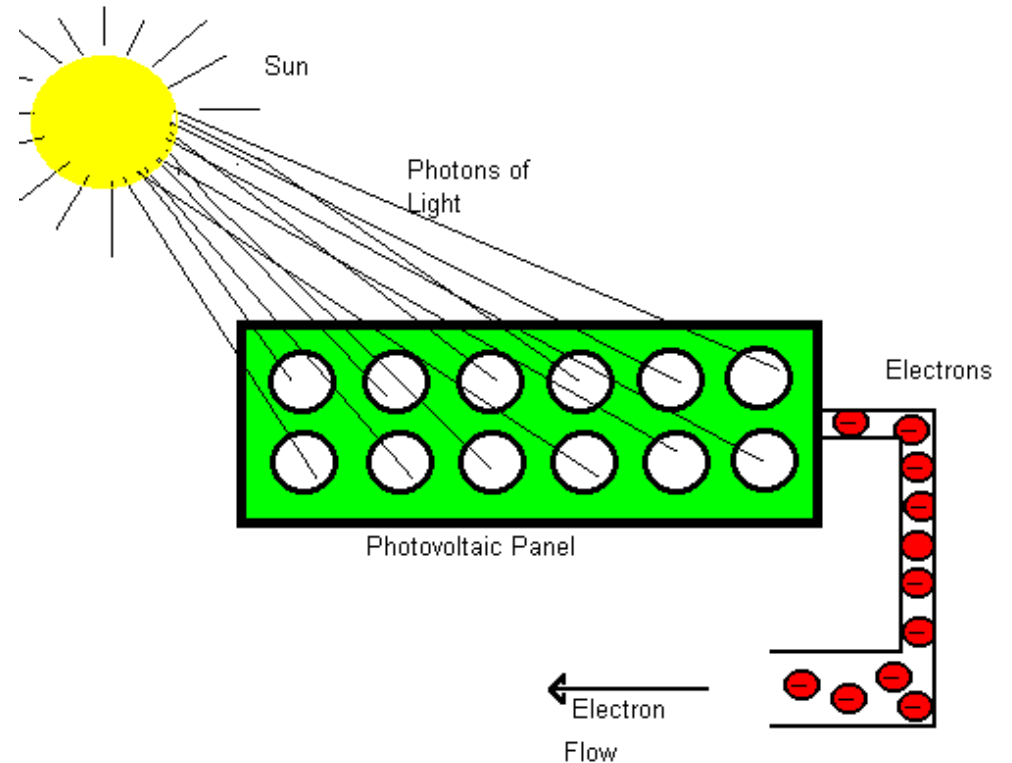


# Photovoltaic Project

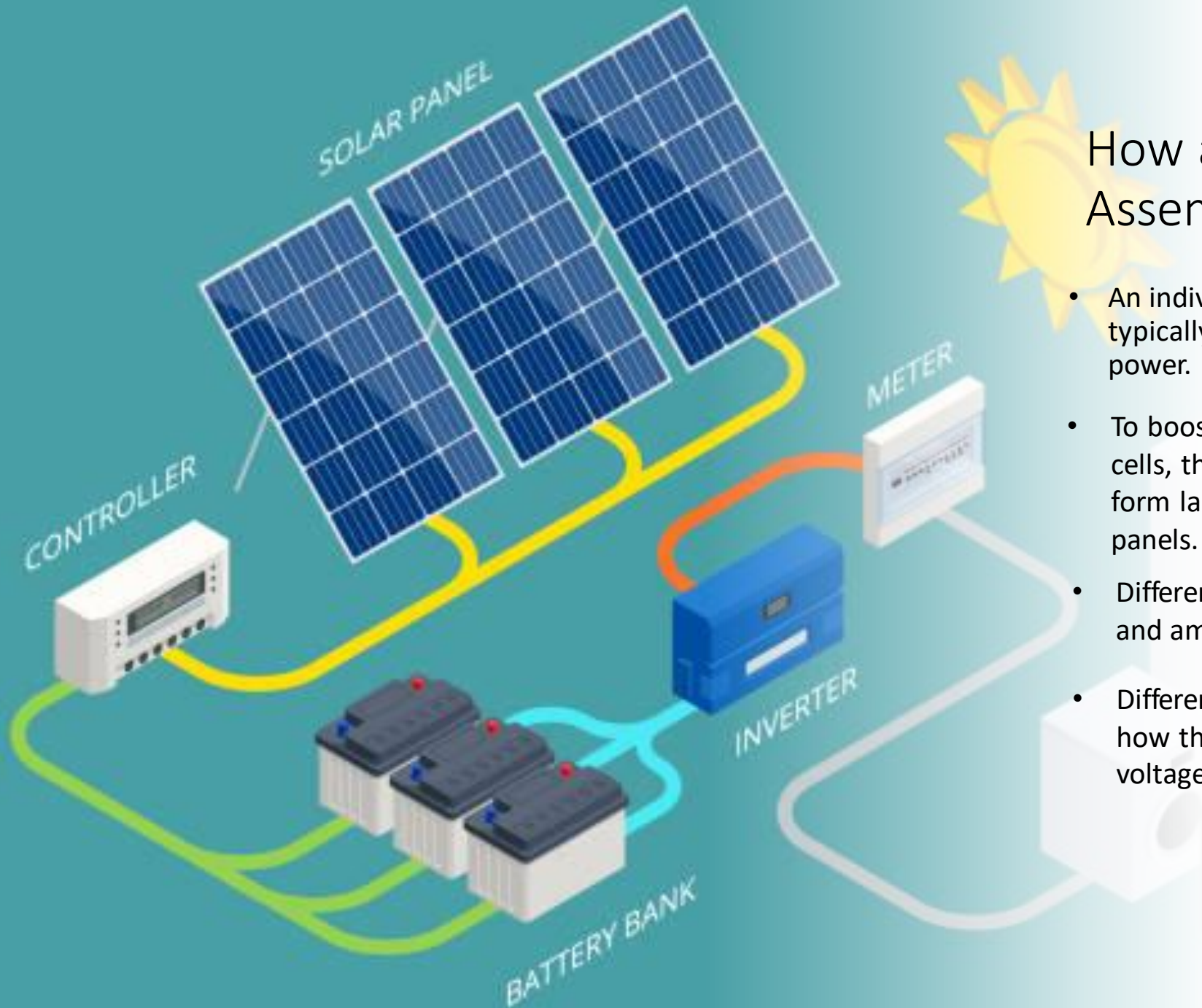
Sabrin and Erika

# What are Photovoltaics

- Photovoltaics are seen in everyday life but not always noticed- Solar Panels
- A PV system needs a light source, and PV panels, in most cases a battery for storage may be useful.
- A solar panel works by allowing particles of light, or photons, to break electrons free from atoms, which results in a flow of electricity.







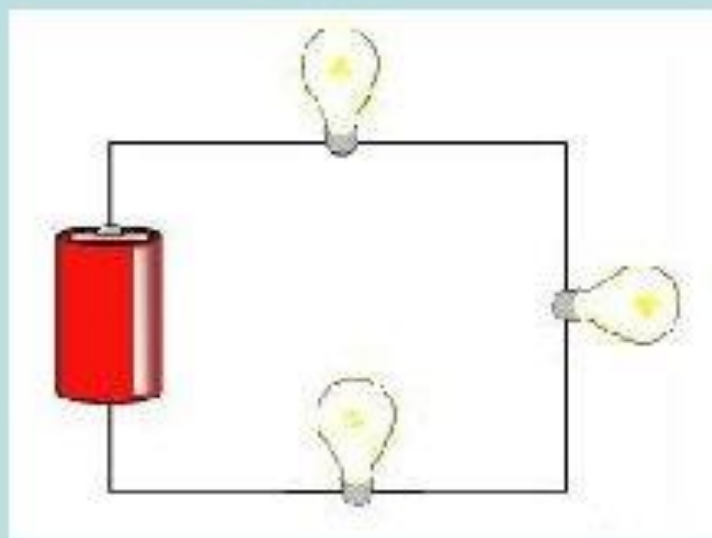
## How are Photovoltaic Systems Assembled?

- An individual PV cell is usually small, typically producing about 1 or 2 watts of power.
- To boost the power output of PV cells, they are connected in chains to form larger units known as modules or panels.
- Different patterned chains increase voltage and amperage differently
- Different tests were conducted to see how the patterns affected the voltage/amperage.

# Series vs Parallel Circuits

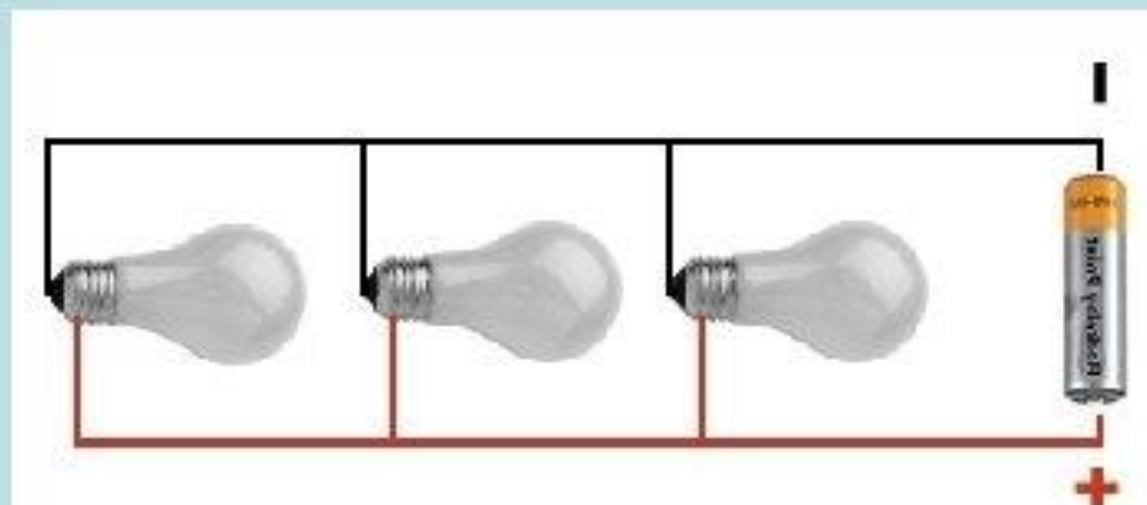
## Series Circuit

- Electrons only have one path to flow through.



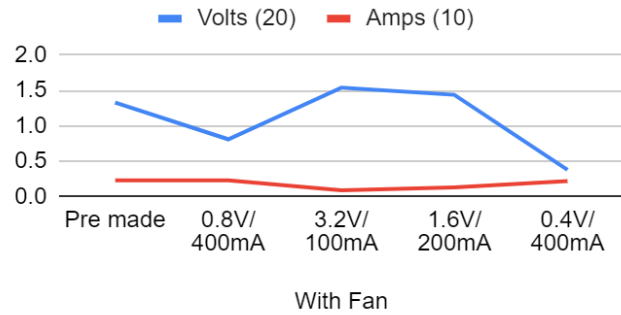
## Parallel Circuit

- There are *MULTIPLE* paths for the current to flow through.

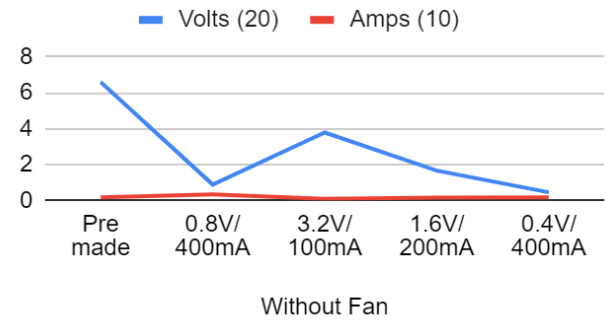




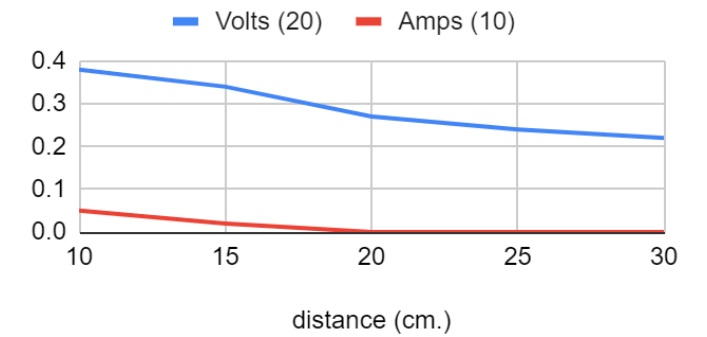
## Sunlight Powered Solar Panels



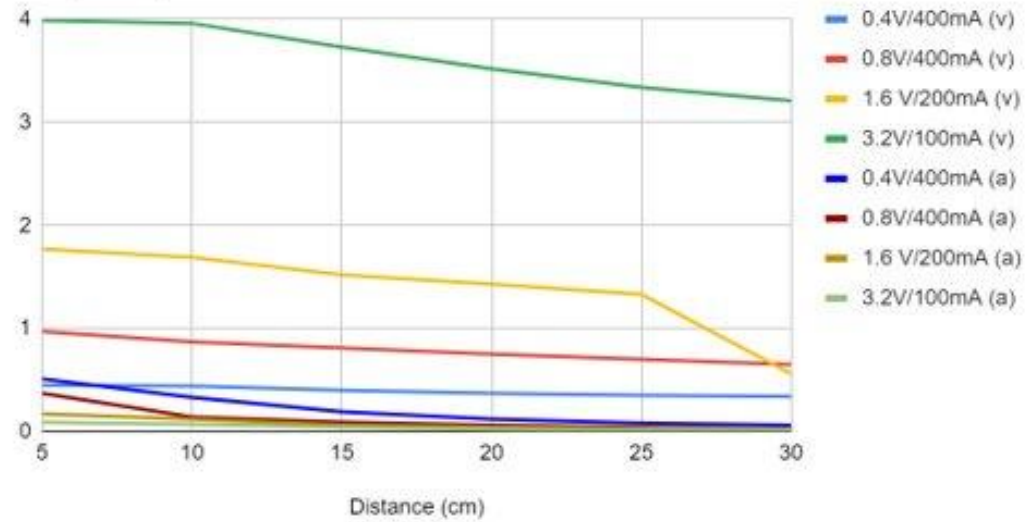
## Sunlight Powered Solar Panels



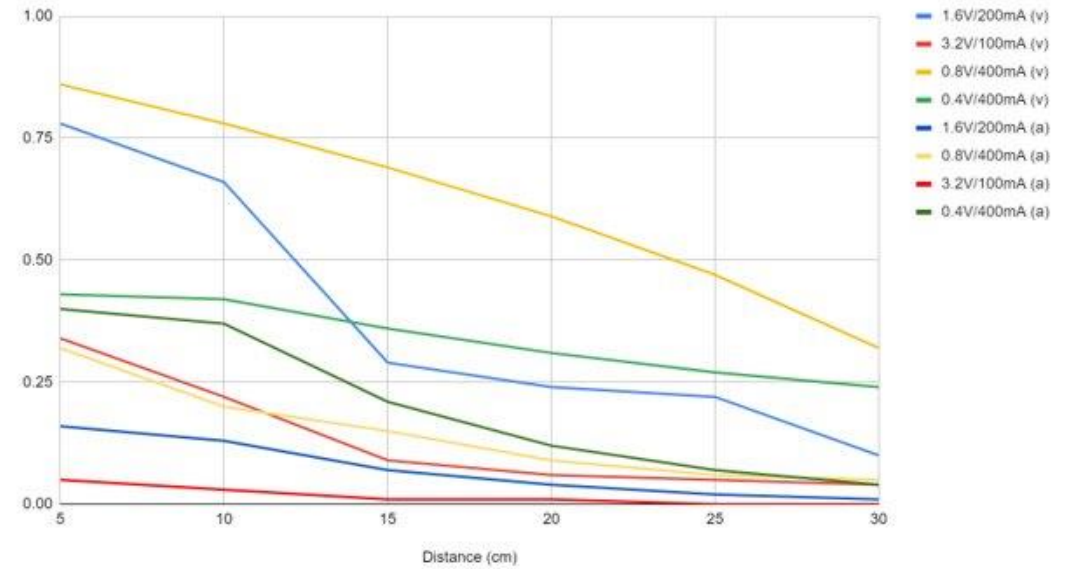
## Single Photovoltaic Fuel Cells



Comparison of Amperage and Volts Over Distance with Multiple Systems w/out Fan



Comparison of Amperage and Volts Over Distance with Multiple Systems W/Fan



\*Not accounted for Human Error\*



# Overall Results/Trends

## With the fan:

- As predicted, there was less voltage and amperage produced by the solar panel as the fan took energy away from the system.
- Results varied greatly from the predicted values.

## Without the Fan:

- As predicted the tests produced more energy than with the fan, even more than what was hypothesized.
- We also discovered that when a panel is chained in series it produces more voltage than amperage and when it is chained in parallel, it produced more amperage than voltage.





WIND ENERGY

# Wind Power Project

Janet and Dylan

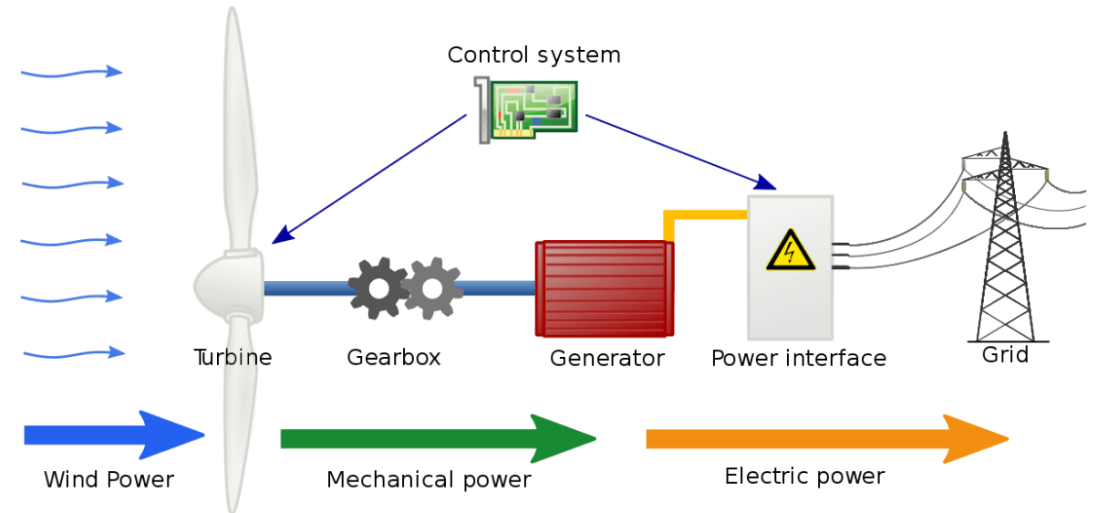
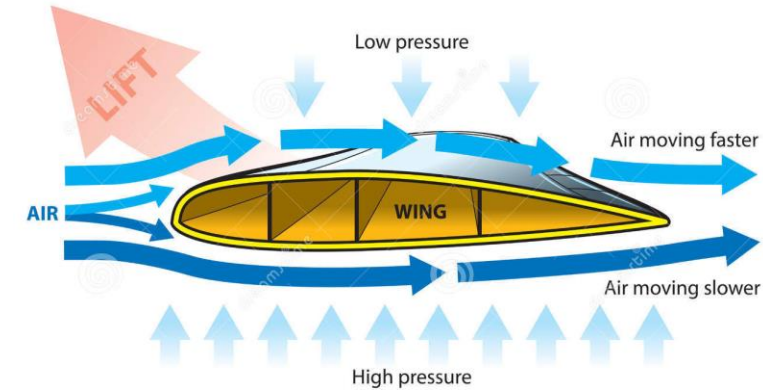
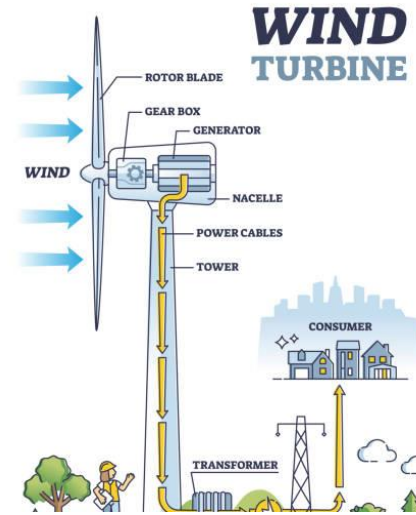


# Function of a wind turbine

- A wind turbine is used to turn wind energy into mechanical energy into electrical energy.
- The blades of a wind turbine function like an airplane's wings.

## Main parts

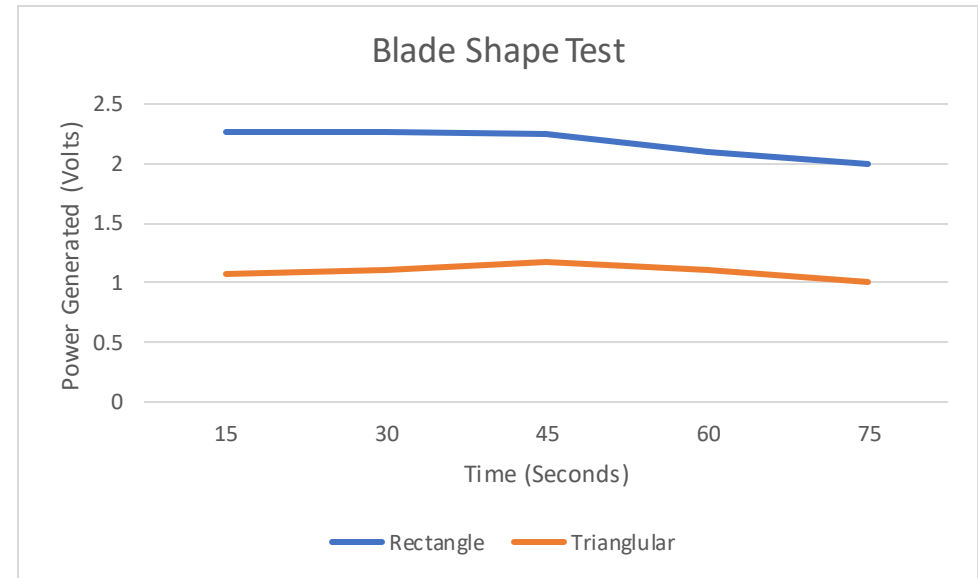
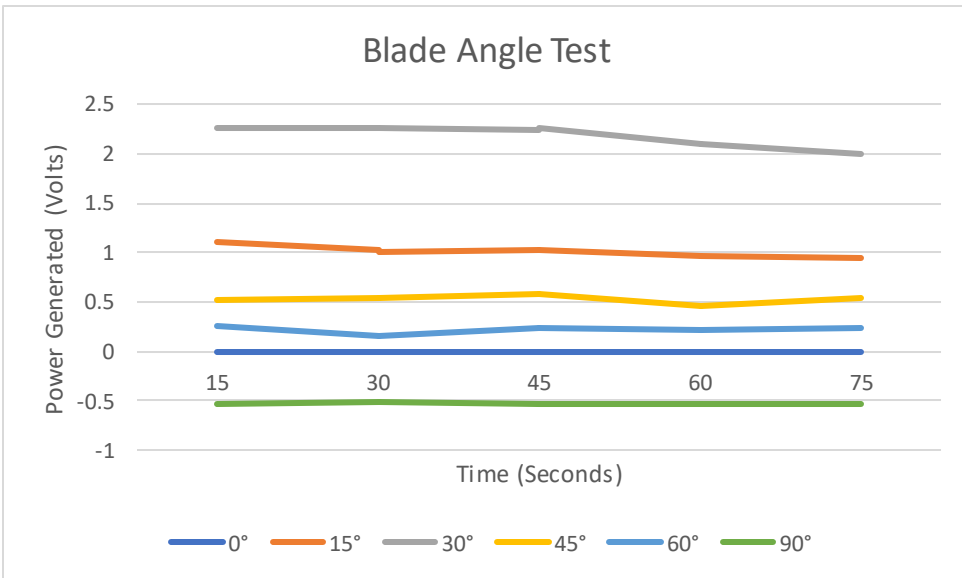
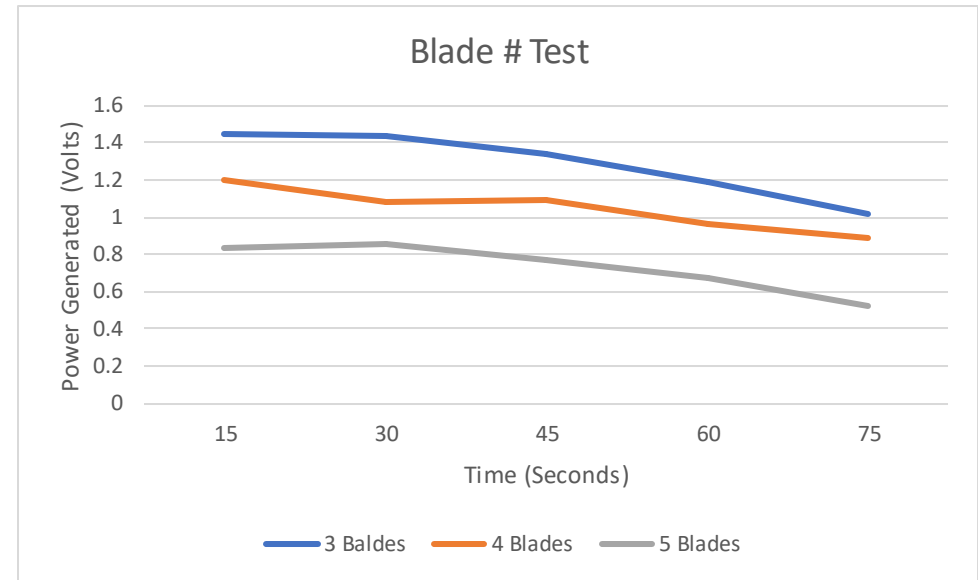
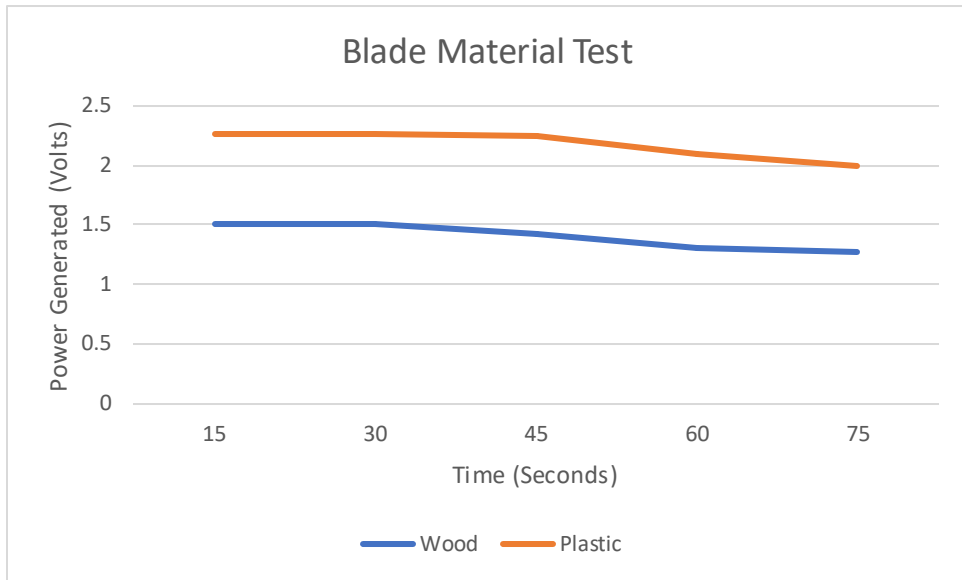
- Tower
- Rotor/hub
- Nacelle
- generator



# Status of wind power

- In CT there is one wind turbine in Litchfield
- U.S has over 135 GW of wind power
- Wind power mainly used in the mid-west
- Recently the U.S has been expanding offshore wind farms





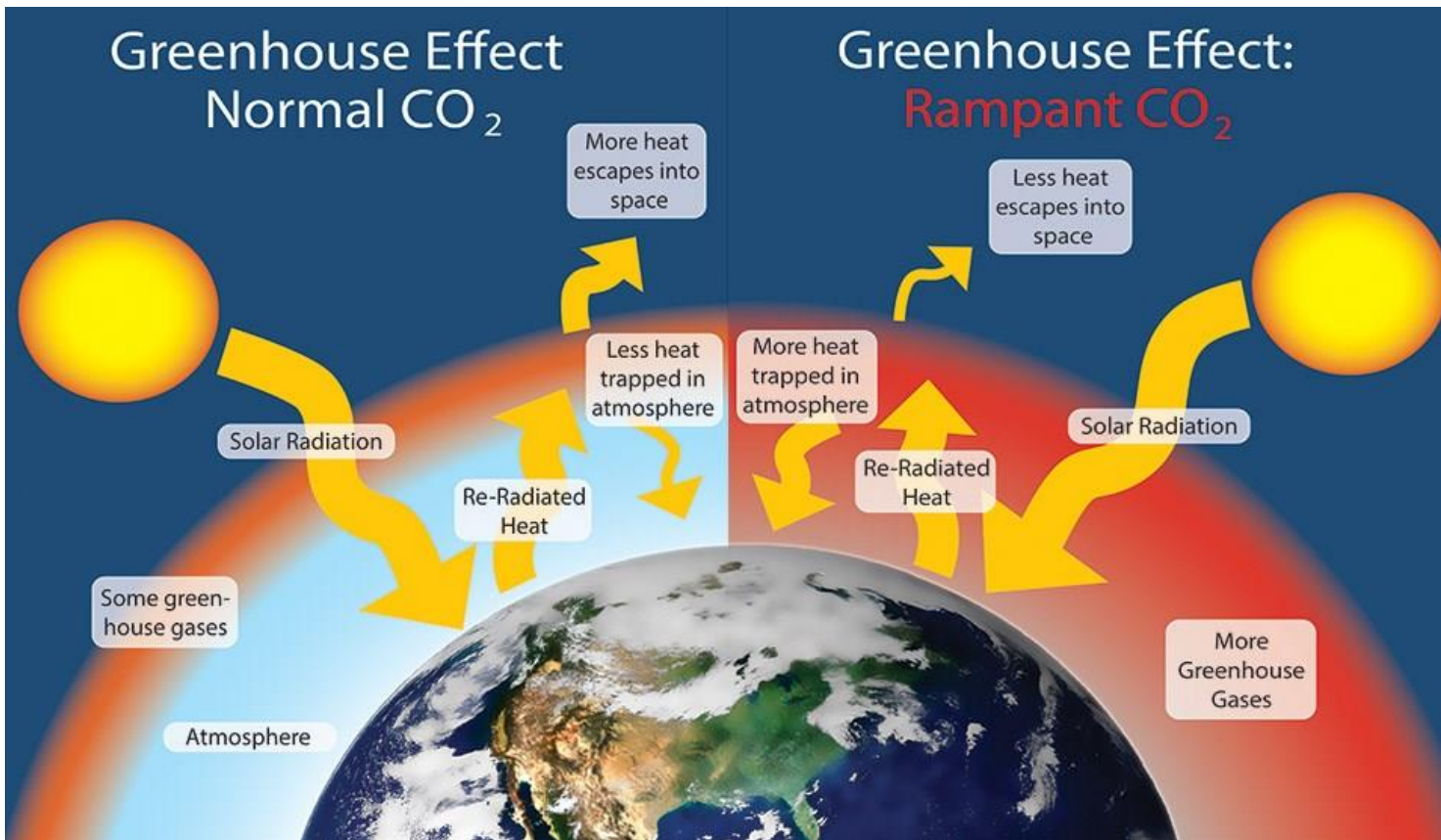


# Results-Wind Power

- Three rectangular blades made of plastic at  $30^\circ$  angles generated the most energy
- When the blade angle was  $90^\circ$  the blades spun counterclockwise instead of clockwise



# SO...WHY



- When fossil fuels are burned CO<sub>2</sub>, particulate matter, and other unwanted compounds are released into the atmosphere.
- CO<sub>2</sub> in the atmosphere can trap heat within the ozone layer.
  - The atmosphere's ozone layer blocks most UV rays from reaching the Earth's surface
- If you've seen the news recently, this is currently happening. Scientists have seen an increase in ecological impacts, flooding, heat waves, melting ice sheets, etc.

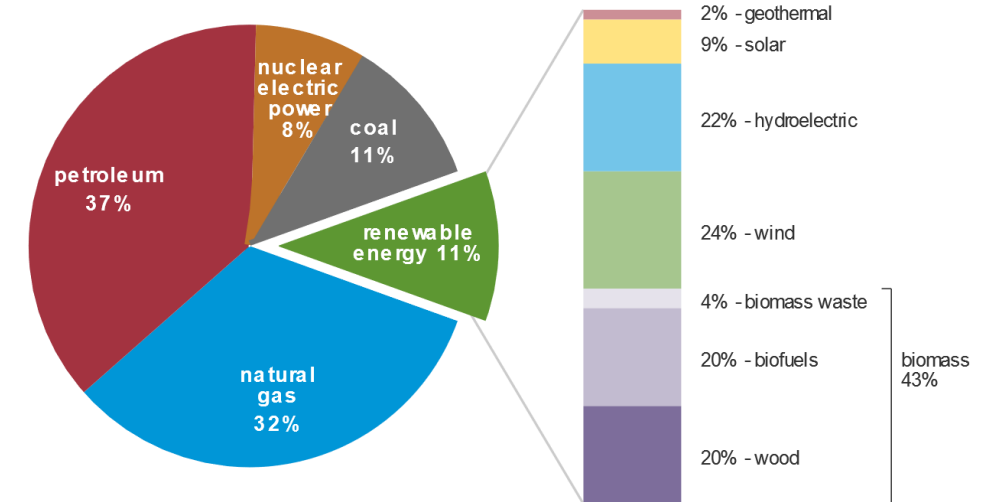
# NOW US. . .

<https://www.iso-ne.com/>

## U.S. primary energy consumption by energy source, 2019

total = 100.2 quadrillion  
British thermal units (Btu)

total = 11.4 quadrillion Btu



- We talked to Chadwick Schroeder; he works as a project manager for the sustainability portion of Bridgeport CT.
- We discussed creating a bike share program and creating more convenient non-fossil fuel options.
- We also discussed the creation of more commercial renewable energy sources and putting solar panels on public facilities and new homes that are being built.





# Prof. Steffen's House System

---

- His system costs \$12.84 for connection to UI and \$90/month to lease the panels. He is saving about \$45 a month.
- Since his system can only produce electricity when there is sun, he still uses energy from the grid for the winter or at night.
- However, he doesn't store energy. The energy he doesn't use runs back to UI and to the grid.



# Future Technologies

---

- Hydrokinetic – similar to wind turbines but underwater
- Hydrogen-Oxygen fuel cells
- For example, we made a fuel cell car



Some fun adventures ;)