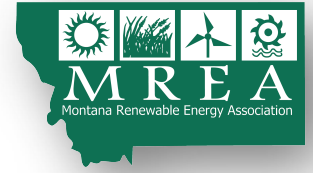


# Renewable Energy Basics

## Montana Renewable Energy Association

# Outline

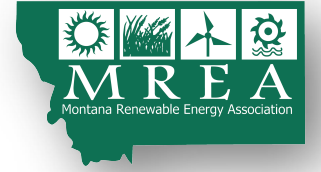
- What is energy?
  - How to measure energy
- Generating Electricity
- Types of Renewable Energy
- How Solar Energy Works
- How Wind Energy Works





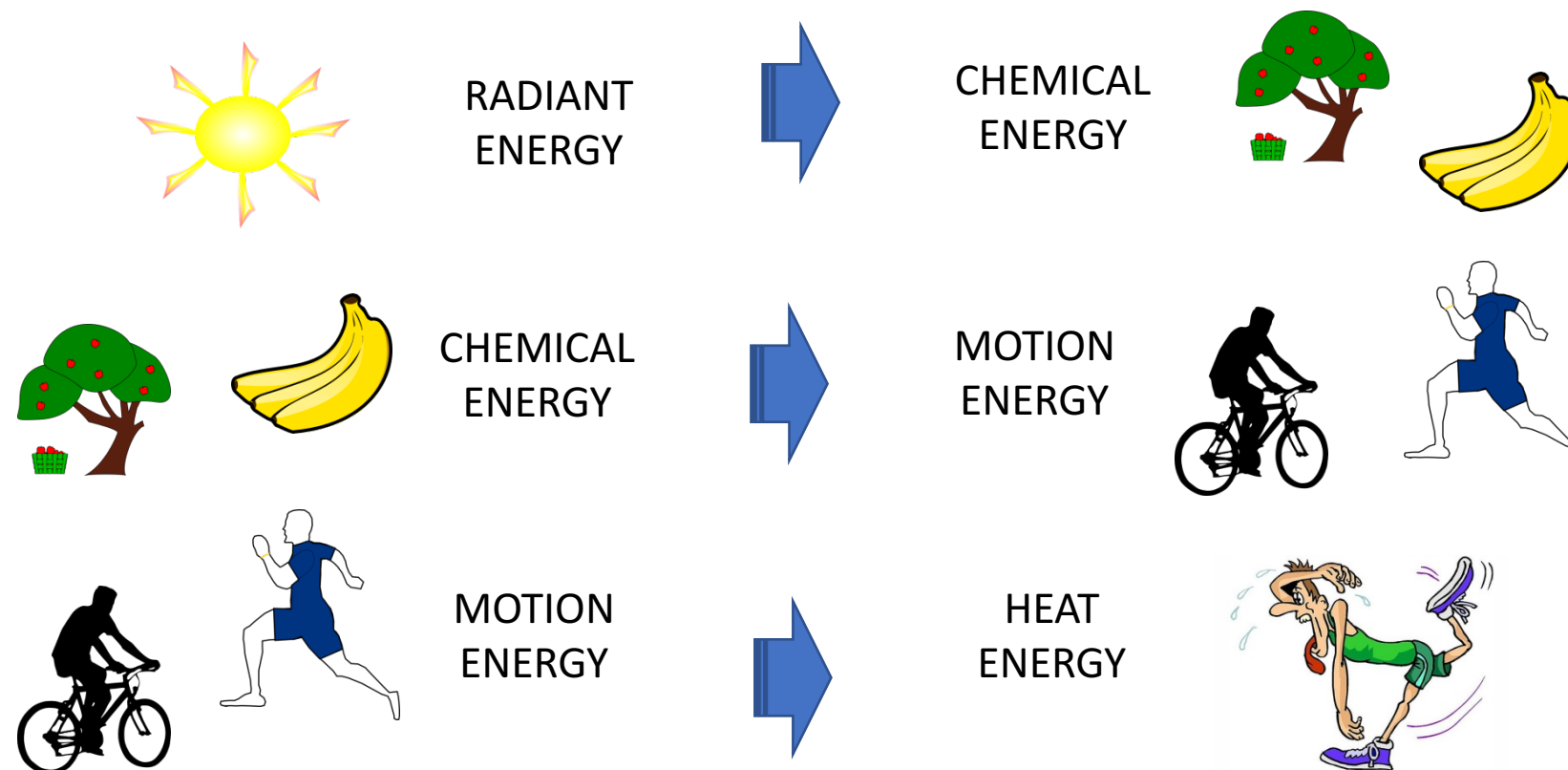
# Outline

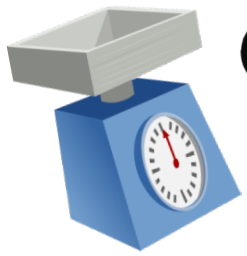
- **What is energy?**
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# What is energy?

Energy is what we use to make things...





# How do you measure Energy?

To start, what does energy measure?

*How much power something needs to run for a  
certain amount of time*

POWER is measured in “Watts”

TIME is measured in “Hours”

so

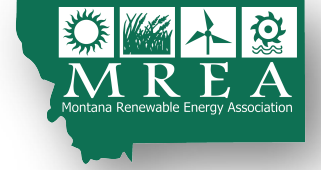
**ENERGY** is measured in

**“Watt-hours” (Wh)**

(1,000 Wh = 1 kWh)

Household appliance	Energy used (annual average)
Air conditioner	1,250 kWh
Electric furnace	11,000 kWh
Clothes dryer	950 kWh
Clothes washer (hot water)	1,450 kWh
Clothes washer (cold water)	110 kWh
Refrigerator w/freezer	950 kWh
Dishwasher	350 kWh
Oven	500 kWh
Microwave oven	175 kWh
Television	250 kWh
Water heater	6,000 kWh

# Electrical Energy



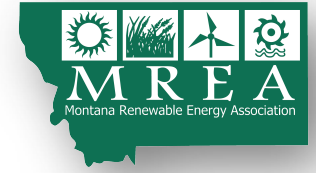
We get **ELECTRICAL ENERGY** from the movement of electrons

And we get **ELECTRICITY** when from electrons flow through something.



# Outline

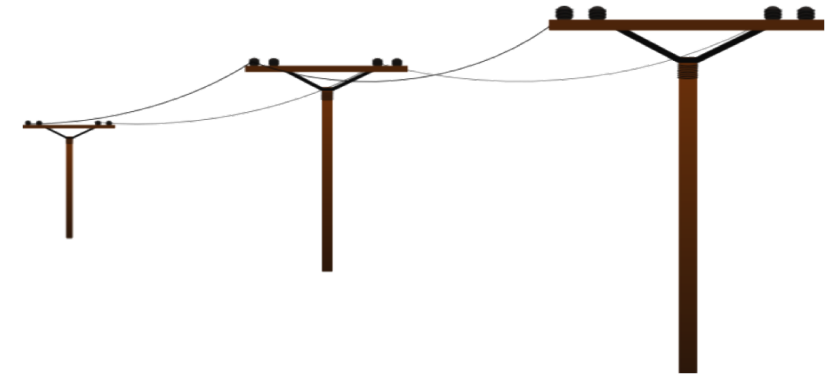
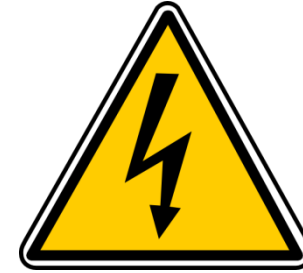
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Electrical Energy must first be *produced*...

...and then *transmitted* and *distributed*...

...before it can be *used*.





# How is electricity produced?

## Non-renewable

- Oil & Petroleum



- Natural Gas



- Coal



- Uranium  
(Nuclear)



## Renewable

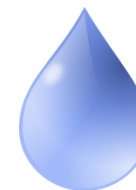
- Solar



- Wind



- Hydro



- Geothermal



- Biomass



# But first... key differences

## **Non-renewable**

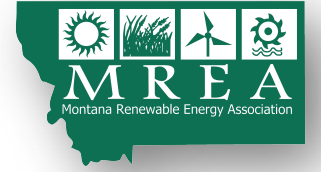
- Replenish over a long time frame (limited supply)
- High GHG emissions

## **Renewable**

- Replenish over a short time frame (non-limited supply)
- Low/No- GHG emissions

# Outline

- What is energy?
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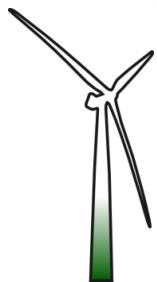




# Types of Renewable Energy



- Solar – **Solar PV** and Solar Thermal



- **Wind** – wind turbines



- Hydro – dams on rivers



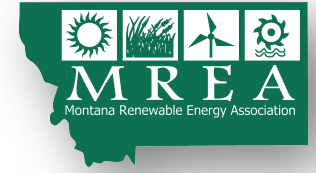
- Geothermal – use the heat of the earth



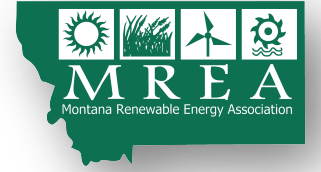
- Biomass – burning a fuel like wood or algae

# Outline

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# Solar Photovoltaic



“Photo” = light

“Volt” = electricity

Photos carry solar energy

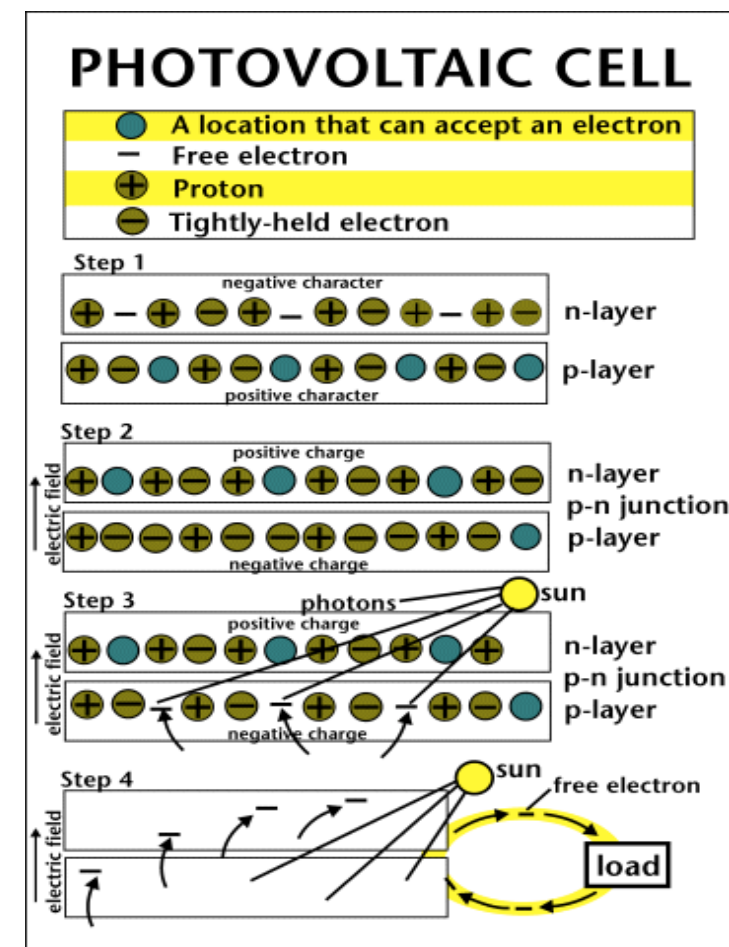
“PV” panels convert  
sunlight into electrical  
energy





# How does Solar PV work?

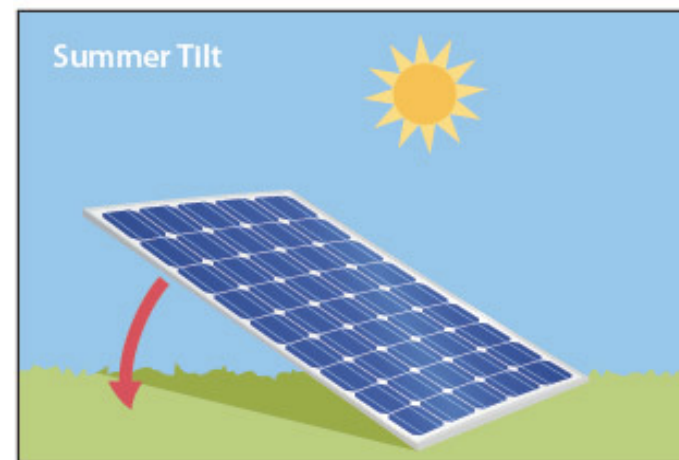
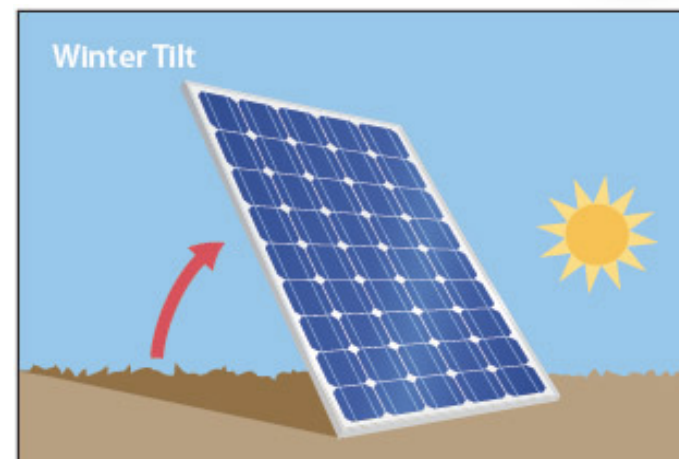
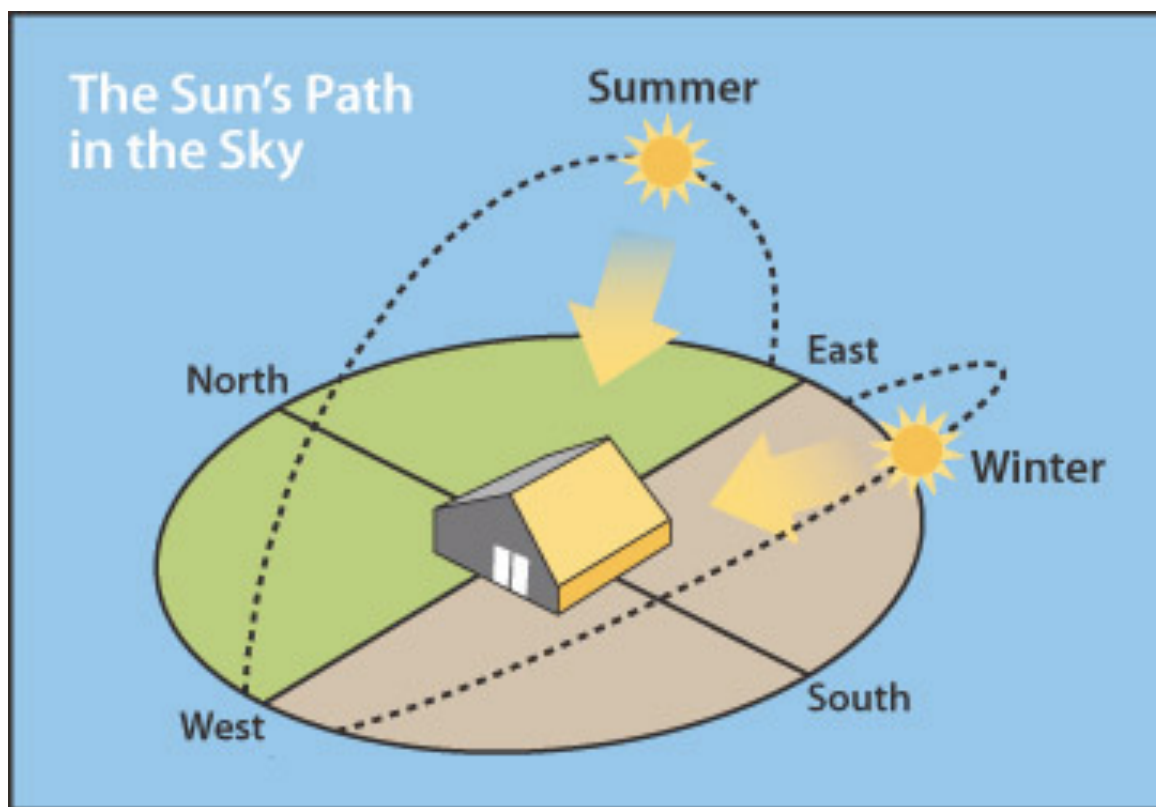
- Semiconductor material absorbs sunlight
- Release of electrons creates a voltage difference between positive and negative
  - Just like a battery
- A conductor connected to a circuit allows electricity to flow



Source: Energy Information Association

# Getting the most out of it

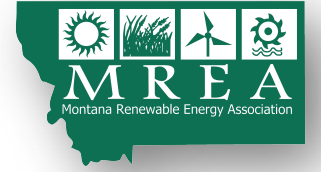
Optimal angle can range from 20-60°



<http://www.myscsolar.com/content/solar-basics>

# Outline

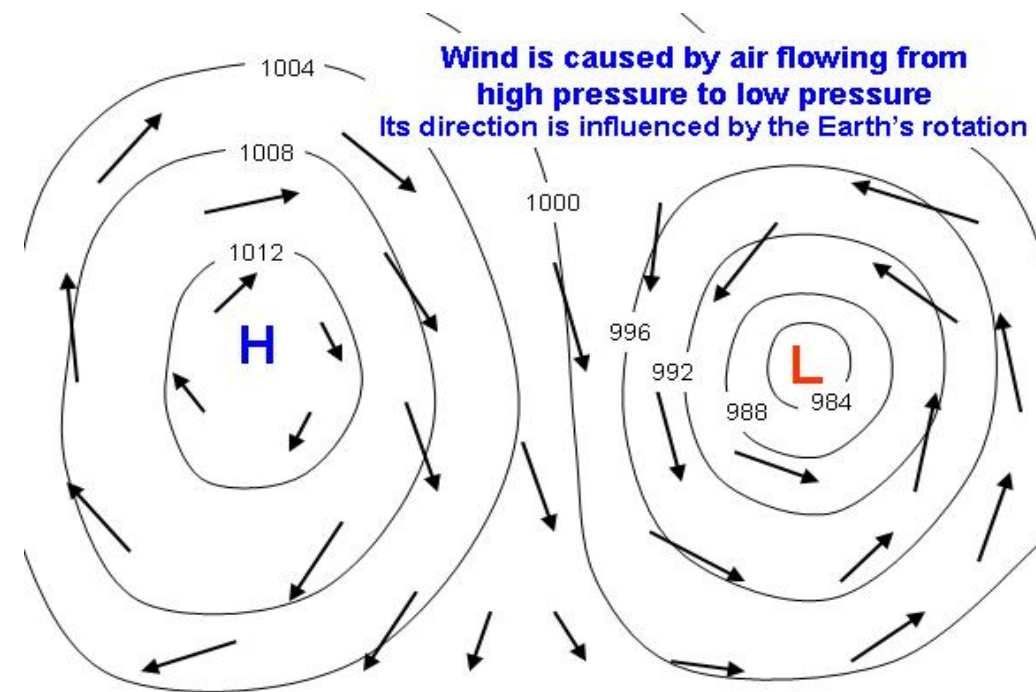
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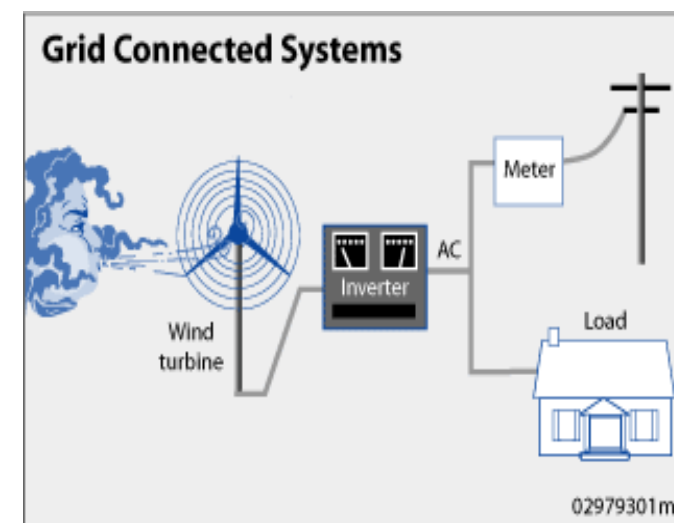
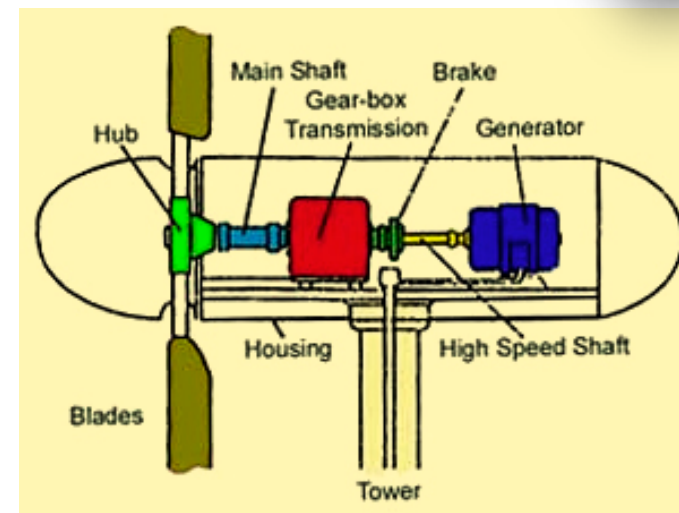
# What is wind?

- Sun heats the air
- Creates a difference in temperature and pressure
- Looking for balance...  
Flow: High Pressure → Low Pressure
- Direction is influenced by the Earth's rotation

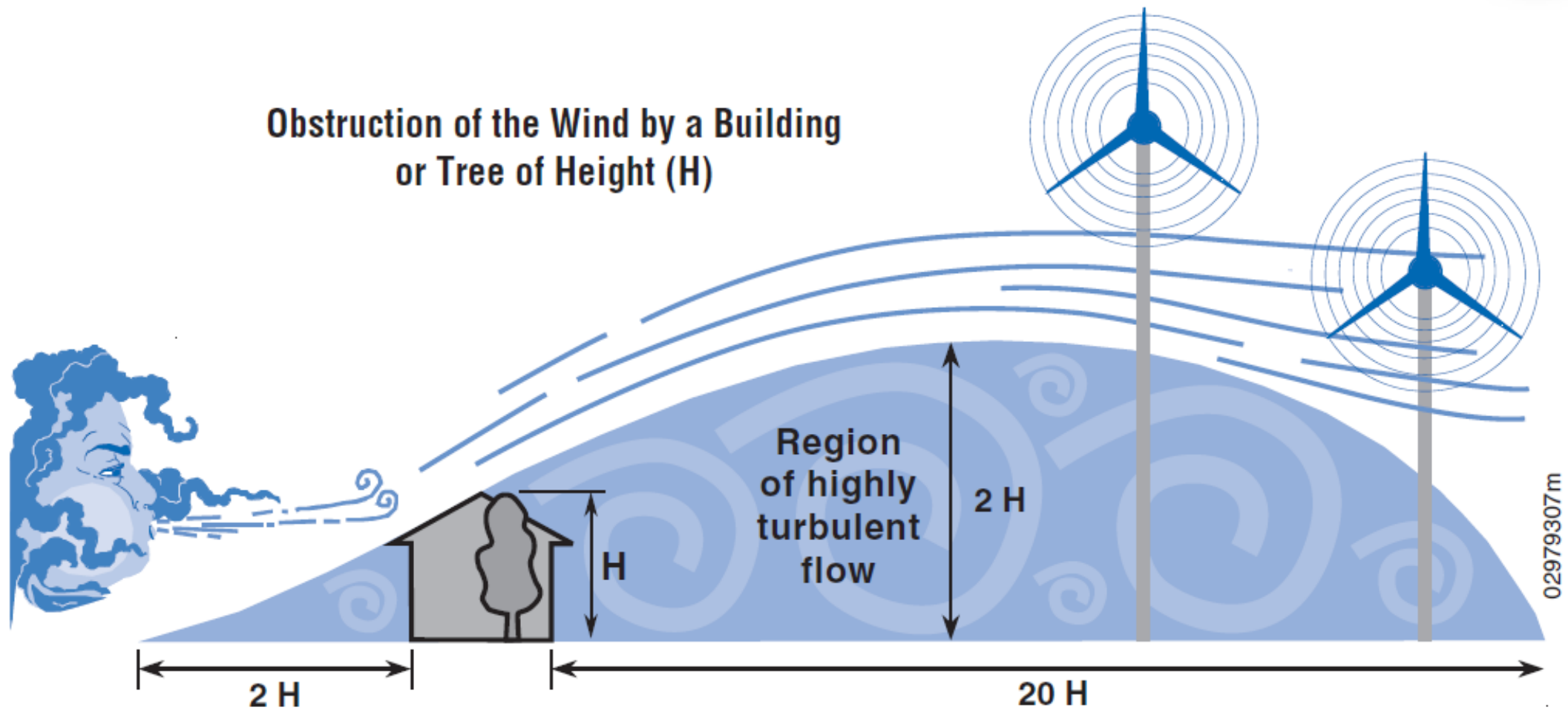


# How do turbines work?

- Wind spins the blades
- The blades are attached to a hub that is mounted on a turning shaft.
- The shaft goes through a gear transmission box
- The transmission is attached to a high speed shaft which turns a generator that makes electricity.
- Electricity is generated and sent through a transformer



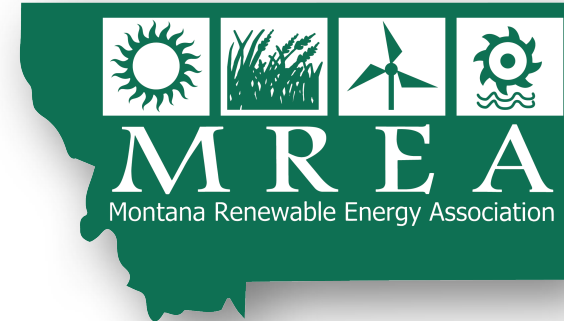
# Why so tall?





# About Montana Renewable Energy Association

- Membership based,  
Non-profit organization



- Mission
  - Expand the use of renewable energy in Montana
  - Affect public policy in favor of renewable energy
  - Educate and inform the residents of Montana of the benefits and uses of renewable energy

Learn more at:  
**[montanarenewables.org/learn](http://montanarenewables.org/learn)**