# Renewable Energy

**General:**

* In the last several years, natural gas has surpassed coal as the greatest source of power generation.
* Currently, the two biggest renewable energy sources are hydroelectric and wind.

**Figure 1. 2016 Electricity Generation by Power Source**

*(Courtesy, US Energy Information Administration, www.eia.gov*



**Solar**

* General:
	+ The sun is our greatest power source.
	+ 173,000 terawatts of energy are hitting the earth at any one moment (10,000x the world’s energy use!).
	+ Solar panels can help capture this energy and convert it into electricity for us to use.
* Efficiency:
	+ Typical solar panels convert ~14% of available energy to electricity.
	+ The best solar panels convert up to 22%.
		- Efficiency is improving every year!
	+ Typical lifespan of solar panels is at least 25 years (energysage.com).
	+ Contrary to popular belief, solar panels can still capture energy on cloudy day.
	+ The amount of installed solar capacity installed in the last 10 years has smashed 2006 goals by 4813%!
	+ They are even beginning to make solar panel roof shingles to renewably power your home!



Solar Roof via Tesla.com

**Ground Source Heat Pumps:**

* Ground source heat pumps utilize the relatively constant heat of the Earth (~50 degrees F) to heat and cool homes.
	+ How it works:
		- They work by passing fluid (usually water and antifreeze) through a tubing system in the ground.
		- As the fluid passes through the pipes, it either picks up heat from the earth (heating mode) or expels heat into the earth (cooling mode).
		- The fluid then returns to heat or cool the house via a heat exchanger.
* GPHS are typically 25%-50% more efficient than standard home heating/cooling systems (furnace, A/C, electric baseboards) and have substantial emissions reductions.
* Systems last 25 years for in-home components; 50+ years for the ground loop (energy.gov).

**Hydroelectric:**

* Water is constantly moving around the globe in the form of rivers, oceans, clouds, and precipitation. Capturing energy from the movement of water is a great way to generate renewable electricity. In fact, hydropower is the biggest generator of renewable energy in the US.
	+ How it works:
		- Water moving downstream flows through turbines (such as those housed in a dam), causing the turbines to spin, which drives a generator to produce electricity.
		- The reservoir behind the dam acts similar to a battery-- storing the water’s kinetic energy until it is needed. When energy demands are high, water can be released to spin through the turbines to generate electricity.
	+ While hydroelectric power doesn’t lead to as much air and water pollution, it can significantly alter the surrounding environment, negatively impacting plants, wildlife, and people living in nearby communities.

**Wind:**

* Wind energy can be used in a similar scope as solar (to power homes or other small buildings).
	+ How it works:
		- Wind drives a turbine which drives a generator which produces electricity.
		- A minimum wind speed of 4-6 mph is needed to reliably produce electricity.
		- Because wind speed increases with height, the taller the turbine the greater wind speed they’ll be able to access. However due to regulations, most turbines can only be 30m tall.
		- Wind energy is highly site specific, as wind speed varies greatly throughout the country (see map).
	+ Wind turbines convert about 45% of the wind passing through the blades to electricity (energy.gov).
	+ It is one of the lowest priced energy sources today! (energy.gov)
	+ Unfortunately wind power can cause disruptions in bird and bat migrations, causing many fatalities every year. Practices are being implemented to help mitigate these fatalities.

**Biomass:**

* Biomass energy is energy derived from burning plants and other organic materials such as crops, woody plants, algae, and the organic components of municipal and industrial waste.
	+ How it works:
		- Biomass can be burned directly as a power source, or converted into a variety of fuels that can be used to power equipment and machinery.
		- Common biomass feedstocks include lumber mill scraps, corn grain (ethanol), and soybeans (biodiesel).
		- This feedstock is converted into power or fuel to be used in a variety of instances.
	+ Biomass reduces our dependence on fossil fuels.
	+ Because biomass fuels can be made from many different organic products, locations can use whatever feedstock is most readily available.
	+ Biomass doesn’t produce carbon emissions and can help reduce industrial waste.

**Where we’re heading:**

* Renewable energy like solar and wind have become much more economically viable options in the recent decade due to significant advancements in technology.
* According to recent analysis performed by the Natural Resources Defense Council, the US is greatly surpassing the clean energy targets it set in 2006.



**Questions for HS and above**

* Renewable energy sources account for what percentage of US energy production?
	+ Less than 1%
	+ 5-10%
	+ **10-15%**
	+ 20-25%
* What is the current efficiency that can be reached by a typical solar panel?
	+ 8%
	+ **14%**
	+ 20%
	+ 25%
* Biomass fuels can be made from which of the following feedstocks?
	+ Lumber mill scraps
	+ Corn grains
	+ Soybeans
	+ **All of the above**
* What is the minimum wind speed needed for a windmill to produce reliable electricity?
	+ 1-2mph
	+ **4-6mph**
	+ 8-10mph
	+ 10-12mph
* Which of the following are benefits of a ground source heat pump?
	+ They are 25-50% more efficient than existing home heating systems
	+ GSHPs release significantly less emissions than typical home heating systems
	+ **A and B**
	+ None of the above
* What are the two biggest sources of renewable energy
	+ Solar and wind
	+ **Wind and hydro**
	+ Biomass and hydro
	+ None of the above