Solar Power versus Wind Power

We have all seen solar panels on roof tops and wind turbines along the highway. Today I'd like to share some information about why we are seeing more of both of them.

We have heard the term carbon foot print in the news but what is it? The World Health Organization definition is "a measure of the impact your activities have on the amount of carbon dioxide (CO2) produced through the burning of fossil fuels and is expressed as a weight of CO2 emissions produced in tons".

Transportation, house and energy (type of house, how big the house is, appliances used, type of heating, and the number of occupants), and your food consumption and life style (food, waste management, etc.) all factor into determining your personal carbon footprint.

All products have a carbon footprint that includes manufacturing, distribution, use, and disposal.

Two ways to reduce our carbon footprint is the use of solar power and wind power. After the oil embargo in 1973 the US government started supporting renewable energy, and in 1978 passed the energy tax act to provide tax credits for solar panels and wind turbines for home use. In 1990 wind power was 1% of the electric generation increasing to 8.4% in 2020. Solar power was 0.01% in 1990 and 2.5% in 2020.

Wind Power

The earliest recorded evidence of using wind energy is around 6000 BC, when the sail was invented to propel boats.

Wind mills are the traditional machines that farmers use to bring water up from a well to water livestock and gardens. Wind turbines are electrical generators that are powered by the movement of the wind.

Wind turbines can be tied to the electrical grid or to a battery storage system. In the wind turbine world bigger is better, and the higher the altitude the more wind.

In 2020 the average utility scale turbine hub was 295 feet or the height of the Statue of Liberty. If you would like to put one in your yard in Great Falls regulation requires the tower to be at least 80 feet high.

Wind turbines harvest about 50% of the energy that passes through them. They do require major maintenance every 5 years that might include taking them down and rebuilding them.

An average home uses about 800-900 kilowatt hours per month; a wind turbine in the range of 5-15 kilowatts can produce the bulk of the electricity to the household with winds in the 5 to 35 mph range. Great Falls average wind speed is 13 mph. Commercial turbines can use wind up to 55 mph.

Wind Power Pros	**Wind Power Cons**
Easily designed for utility scale	Requires too much space for most residential applications
Capable of generating power any time of day	Requires more maintenance than solar panels
More efficient than solar panels	Higher upfront cost than solar panels

Solar Power

Solar energy has been used since 700 BC, when mirrors concentrated the solar heat to make fire. Solar cells to generate energy started in 1839 but weren't practical for another century.

There are 3 types of solar energy:

photovoltaic – produces electricity

solar thermal – used to heat water or air

passive – directly takes advantage of the sunlight (sunlight coming through a window heating the room)

Photovoltaic solar energy converts sunlight into electricity. This is done when sunlight reacts with the silicon cells in a solar panel. This reaction breaks the sunlight into electrons and protons which create electricity as they move. A group of solar cells is a solar panel, a group of panels is an array. The more arrays in a group the more electricity is possible.

Solar thermal energy is collected by using mirrors to concentrate the sun's heat, transferring that heat to a liquid like water, and running the heated liquid through a building giving off heat. This is the same principle as the church boiler but using the sun instead of burning natural gas.

The power capacity of the best solar panels averages between 250 and 400 watts and the most efficient panels reach efficiency levels of 20%, meaning that 20% of the energy hitting the panel converts to electricity. A typical solar array is 10 to 30 panels with the average being 20 panels. The cost of installation is between $20,000 and $40,000 depending on the size and complexity of the installation. Even with this high cost the decades of energy savings can top $50,000 over the life of the system which is 25 plus years. Most homes that use solar panels remain tied to the electric grid so there is no loss of power when the sun isn't shining and there is no need for back up batteries. Being tied to the grid gives the homeowner the option to sell any extra power generated back to the electric company which lowers the home's electric bill every month. It is up to the power company to make this option available and to determine how much they will pay for the power (always less than they charge).

Solar Power Pros	**Solar Power Cons**
Easily designed for residential purposes	Only generate electricity when sun is shining
Cheaper to install than wind turbines	Not suitable for every home
Little to no maintenance over 25+ year life span	Less efficient than wind turbine
100% renewable energy	High initial investment
No toxic or polluting emissions into the air during use	
Reduces the use of fossil fuels	
Reduces reliance on electrical grid or natural gas, depending on how the system is installed	

Environmental Impacts of Solar Power

These impacts are for solar panels but many of them also apply to wind turbines or anything that is manufactured.

Solar cells are made up of silicon semiconductors and glass along with metals like silver, copper, indium and terrarium and lithium if batteries are included. The mining of these metals creates greenhouse emissions and can lead to soil, air, and water pollution. A lot of the energy used to melt the silicon comes from burning coal especially in China. The cooling process requires lots of water. Raw materials for solar panels are shipped to the manufacturer (e.g., China) and then the finished panels are shipped to the end user around the world, all of which creates greenhouse gases.

Solar panels last on average 25 years and currently there is no large-scale system for recycling the precious metals so more have to be mined to make replacements.

The mining and burning of coal generate a carbon footprint 18 times the size of solar panel production, natural gas is 13 times the size of solar.

Solar panels are an essential solution to slowing climate change but new technology is needed to minimize the effects of production and to improve recycling of the old panels.

As stewards of the Earth, we need to look for every possible and practical way to make the world better for future generations. Both wind and solar power need to be added to our daily lives but in reality, the upfront cost is often very high. If you are interested, it is recommended that you look into possible grants or other new technology that is making urban power production more affordable.