Evergreen Conservancy

Additional Resources

Environmental Resources
- www.pennfuture.org
- www.epa.gov

Energy Resources
- www.nrel.gov
- www.energy.gov

Wind Resources
- www.choosepawind.com
- www.pawindenergynow.org

Solar Resources
- www.pasolar.org

These are just a few of many!

The Renewable Energy Project was developed with the support from the following:

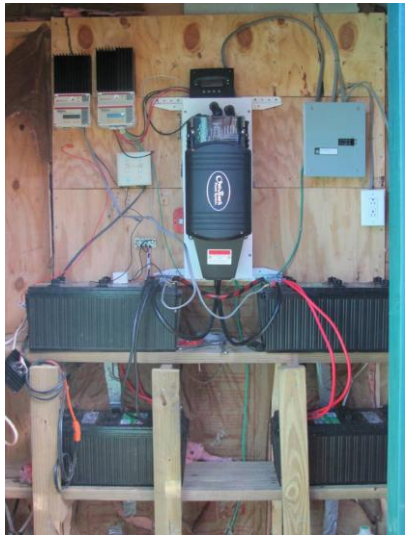
- Sprout Fund/ Community Connections
- Pennsylvania American Water
- Dominion Foundation
- Penelec Sustainable Energy Fund of the Community Foundation for the Alleghenies
- Foundation for Pennsylvania Watersheds
- The Sprout Fund/Spring Program
- EPCAMR/ Western Pennsylvania Coalition for Abandoned Mine Reclamation (WPCAMR), ARRIPA
- Indiana Parks and Recreation
- The many individual and groups of volunteers and members of Evergreen Conservancy!

Developed 2013 with support from:

PENNSYLVANIA AMERICAN WATER

Renewable Energy Project

Tanoma AMD Wetlands Treatment System Environmental Education Center



This panel powers a probe that monitors water quality 24/7

Evergreen Conservancy

Tanoma AMD Wetlands

The main purpose of the Tanoma AMD wetlands system is to remove the iron from the abandoned mine discharge that would otherwise enter the local watershed.

Tanoma was immediately recognized as a great tool for education on pollution, the watershed, the use of natural systems for water restoration, alternative energy, stream ecology, water testing, birding, plant and tree identification, and other environmental education issues. Evergreen Conservancy has spent several years developing the area into an outdoor environmental education center, with a pavilion, parking lot, ADA compliant pathways, and signage.

The public can visit the site and take advantage of the self-guided wetlands trail. In an effort to expand the educational aspect of the site, we have installed an off-grid renewable energy system that includes the alternative energy sources of water, wind and sun. On site you can see a micro-hydroelectric generator, a wind turbine, and a solar panel installation in operation. The hydroelectric generator is run by the actual discharge from the AMD water flow.

One way to prevent climate change is to shift our energy economy to the use of renewable energy sources, such as wind, solar, and water power. Renewable energy does not emit greenhouse gases and will not contribute to further global warming. That is why it is important to have examples of renewable energy generation at environmental education sites such as Tanoma.

How You Can Get Involved

Look at your electric needs and think about how you might cut your electric bill with even a small, independent renewable energy system. Every kilowatt counts!

Costs of adding solar in your home are dropping every year and can greatly reduce your electric bill. The initial expense may be pricey, but the number of years before the reduced electric costs pay off your investment may surprise you. Solar shingles have dropped in price and replace ordinary roof shingles. Add in any government tax incentives or rebates, and the cost of a new roof may pay for itself in the long run, as well as helping the environment.

Another simple way you can help the environment is to do what Tanoma has done—purchase an electric lawn mower! Gasoline lawnmowers are many times more polluting to the atmosphere than cars, and accidental spillage of gasoline adds up to a lot of environmental damage. Not to mention, gas lawnmowers are noisier and require more maintenance than electric.

This equipment is powered by electricity generated on-site at Tanoma!

Solar

Solar panels are often called “photovoltaic” or “PV” panels because they use the “photovoltaic effect” to generate electricity. Look at the diagram below to see how they work!

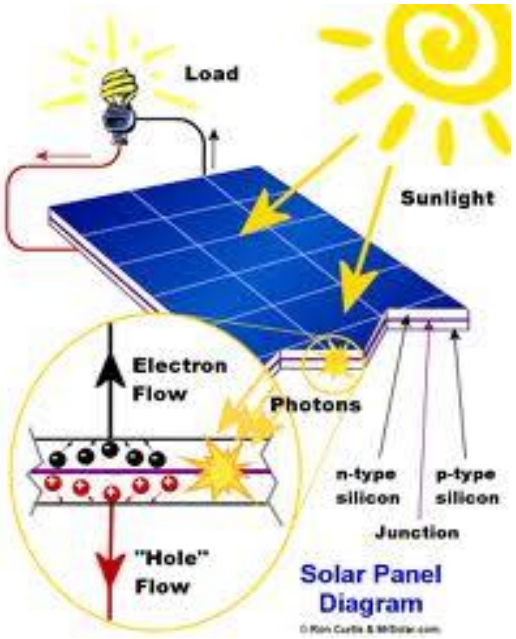


Image from www.mrsolar.com

Figure- Sunlight, which is a stream of photons, strikes specially treated, thin silicon sheets. The photons knock electrons from the silicon atoms, and the electrons are collected in one part of the panel to create an electric current. This current is what gives us power!

Tanoma has an array of 4 solar panels, each delivering 225 watts of peak power, for a total of 900 watts. On average, these solar panels are providing 100 kilowatt hours of power per month, enough electricity to run approximately one-seventh of an ordinary household’s electric needs.

Hydro Power

These mills were used to manipulate raw materials into products like agriculture, textile, lumber, metal. A famous example is a flour mill. At this mill, grains like oats, wheat, rye, and barley were ground on stone that rotated from the circular motion of the water wheel and gears.

More contemporary water turbines utilize different designs other than these classical water wheels. Turbines may use a variety of enclosed blades or cups or exposed vanes or paddles with powerful streams of water directed against them to produce the mechanical power. This power can then be used to turn generators to make electricity. This method of harnessing energy is called hydro-electricity.

Dams are the most commonly known hydro facilities used. Dams create a reservoir (man-made lake) that can control the outflow of water through a water turbine generating electricity. Pennsylvania has several power plant dams that create hydro electricity.

Tanoma has a water turbine, too. It is called an Ampair 100 and is a type of turbine that works well in a flowing stream where there is very little drop in elevation of the flowing water. The turbine is expected to produce an estimated 100 watts of constant 24/7 electrical generation.

New water turbine at Tanoma installed Fall 2013

Why Renewable Energy?

Two words: Global Warming. The scientific evidence is overwhelming that global warming exists and is caused by the human burning of fossil fuels, like coal, oil, and natural gas. During the last century, the global temperature has gone up roughly 10x faster than at any time in Earth's history in the last 2 million years. This is consistent with higher rates of burning fossil fuels and creating greenhouse gases like carbon dioxide and methane that trap the sun's heat at lower altitudes and prevent the stratosphere from being heated. The global warming is definitely not a natural process and is not a result of any of these natural cycles or causes.

If global warming continues unchecked, we will see more severe heat waves and droughts in some areas, and much higher rainfall and floods in other areas, such as we've seen in recent years. Hurricanes, tornadoes, and other storms will increase in intensity and frequency. Sea levels will continue to rise as the polar ice caps and glacier fields melt. Data shows that sea levels have risen significantly since 1870, and since 1993, the rate of sea level rise is accelerating. Many island nations will disappear, and up to 10% of the world's population who live in coastal areas will be displaced by higher sea levels.

In order to remove iron from the discharge, an aerator is used and run by this generator which is powered by renewable energy on site.

How we use Renewable Energy

The electricity generated by the system is used to run aerating "bubblers" in the cells of the treatment system. This will greatly improve the precipitation of iron from the water, because dissolved oxygen (DO) combines with the iron to form the solid substance iron oxide. After the iron oxide is formed, it can be harvested and used commercially—in fact, Evergreen Conservancy collects enough iron oxide to give to local artists for use in their artworks and makes chalk, ink, and tie-dye T-shirts. Using aerating fountains in the passive system to improve the iron precipitation and overall efficiency of the treatment system is fairly standard technology. But using an independent, on-site renewable source of electricity is a "green" solution. In fact, putting the AMD water flow to work in generating electricity to get the iron out is an uncommon approach with a certain "irony" about it—the polluted water is made to work to clean itself up.

Having this renewable energy project available at this site will also add to the educational aspects of our outdoor classroom: standard 110 AC electrical power is available for educational and public events and meetings, running laptops, projectors, displays, and other presentation devices. In addition, the electricity is used for site maintenance for recharging electric lawn mowers, string trimmers, and power tools for other projects. Opportunities to see these innovative technologies in action will help visitors understand how we as a community and as individuals can help to conserve our resources.

Wind Turbines

Over the years, people have found a way to capture the energy of wind to produce electricity. These structures are called wind turbines. Modern wind turbines come in a variety of sizes, shapes, and styles. Typically, turbines consist of blades or some form of a rotating head and a drive shaft connected to a generator. The rotating head creates drag against the wind turning the drive shaft which produces electricity through the generator. With enough turbines on several acres of land, the area is called a wind farm. PA has a few wind farms such as:

- Armenia Mountain (Bradford and Tioga County) 67 Turbines
- Locust Ridge II (Columbia and Schuylkill County) 51 Turbines
- Waymart (Wayne County) 43 Turbines
- Allegheny Ridge (Blair and Cambria County) 40 Turbines

All of the wind turbines you see at these sites are "horizontal-axis wind turbines" or "HAWT's" because the axis of their rotation is parallel to the ground.

The wind turbine installed at the Tanoma Wetland AMD site is a prototype vertical-axis wind turbine (or a "VAWT"). This prototype is approximately 15 ft. tall and 14 ft. across. It rotates in a horizontal plane around the vertical axis, hence its name.

Because it doesn't have sharp, fast-moving blades like the typical horizontal-axis wind turbines now in use everywhere, it poses no threat to birds or other wildlife, and that's an important consideration in a conservancy location which provides a habitat for a number of birds. Flaps in the back of each vane rise and fall as they change their orientation to the wind. This feature allows wind blowing on the backs of the vanes and resisting the turbine's rotation to simply flow through. That greatly increases the efficiency of the turbine, making it comparable in efficiency to the horizontal-axis turbines. We estimate that this turbine will on average provide around 40 kilowatt hours per month to the system.

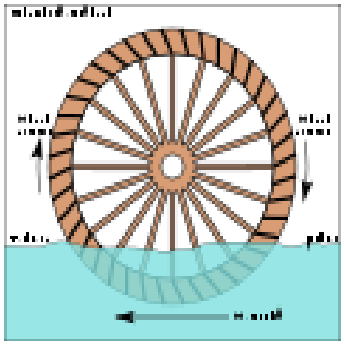
Besides its safety features, the design of this wind turbine allows for a flat, compact installation on building rooftops, making it compatible with locating an array of solar panels above. That is an important aspect of this design, since it is best to combine solar and wind for future residential and commercial applications.

Wind turbine at Tanoma

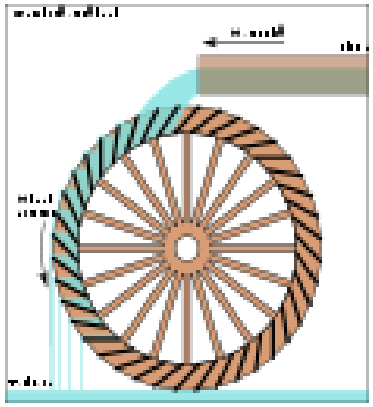
Hydro Power

Water has been used for thousands of years as a power source of energy. You might have heard it called a watermill, water turbine, or water wheel. The basic concept is that a wheel placed in flowing water is connected to a network of gears to be used for a specific purpose. The gears turn creating mechanical energy from the kinetic power of the water passing by the water wheel.

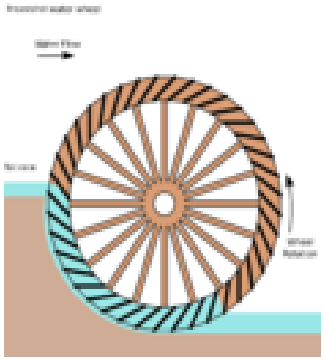
There are three types of designs for wheel placement in a flowing water body: Undershot- water flows under wheel (A), Overshot-water flows over the top of wheel (B), Breastshot-water flows towards middle of the wheel against the bank (C).



A) Under-shot Design



B) Over-shot Design



C) Breastshot design

Image from http://www.top-alternative-energy-sources.com

Wind

Sail boats, wind mills, kites, and weather vanes are examples of everyday items that move, or fly because of the kinetic energy of wind. Wind has been a source of power used by people for years dating back to the early ages of civilization. We actively feel, use and depend on wind, but do you understand where and how wind works? Here is a simple explanation of this common earthly feature:

Air floating over land is warmed by the solar heat during the day. This warming effect causes the air to rise because it is less dense. As it rises, cold air over water flows in to fill the void. At night it is the opposite effect. The sun goes down, the land cools down. The air sinks over land and rises over water. This daily pattern is a continuous movement of air masses that cross the globe. This motion is what we call wind. Land features such as mountains, hills, valleys, prairies increase or decrease the velocity of the wind, creating a variety of speeds depending on location. Also, the west-east rotation of the earth contributes to the motion of wind. Known as the **Coriolis Effect**, in the Northern Hemisphere the wind follows the rotation of the earth. In the Southern Hemisphere, the wind follows the counter rotation flowing east-west. In summary: the heat provided from our sun and the rotation of the earth provide the wind we rely on.