RENEWABLE ENERGY

PLANNER'S PORTFOLIO

ISSUE 5

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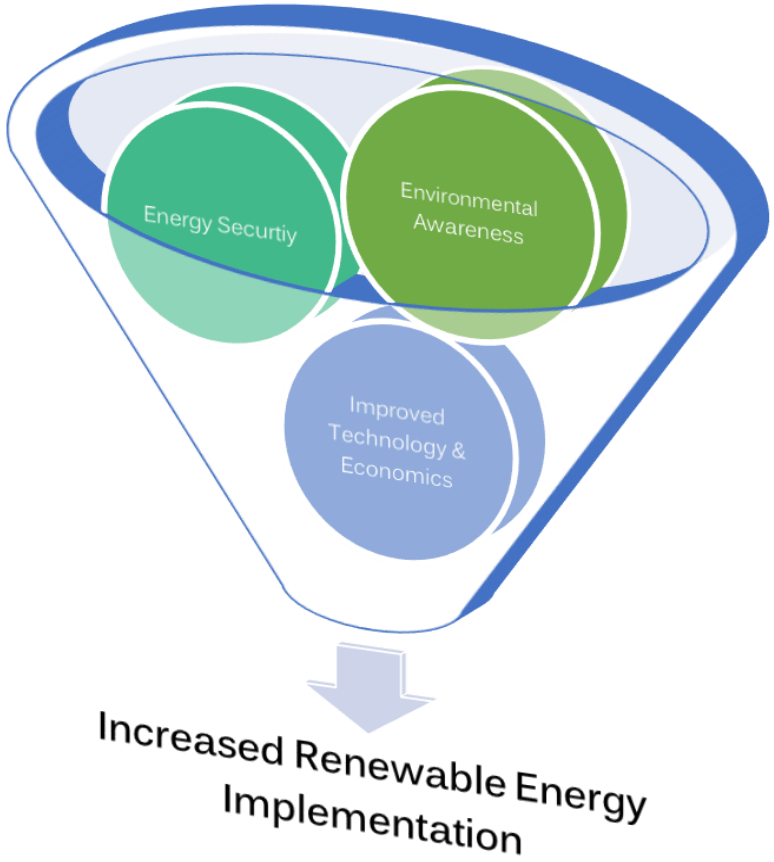
Planner's Portfolio Series

The Planner's Portfolio Series is an outreach effort developed by Delaware County Council in order to explore the planning concepts available for communities to take advantage of the unique opportunities across Delaware County.

The pattern on the cover page, and found throughout this series, represents the importance of each individual component in the larger network. The Planner's Portfolio Series explores several of these components and how they can support community character in Delaware County.

For more information, contact the Delaware County Planning Department at 610-891-5200 or visit https://www.delcopa.gov/planning/planningeducation.html to see the complete Planner's Portfolio series.



OVERVIEW

In an age of wildly fluctuating energy costs and growing environmental consciousness, many property owners are opting to install small-scale renewable energy systems to offset the amount of energy they need to draw from the electric grid. In the past, these systems were too costly to be widespread, but advances in technology as well as government incentives and private investment have caused the system costs to decrease dramatically in recent years. Owing to the relative rarity of renewable energy installations previously, most municipalities have not included language in their ordinances to regulate the location, size, or approval procedure for these systems. While it is uncommon for municipalities to out-and-out prohibit renewable installations in their boundaries, not addressing renewable energy at all can still hinder the process. Approving zoning variances and special permits for renewables can cost both the municipality and the applicants time and money, which can serve to discourage the adoption of renewable energy systems.

This document aims to provide municipal officials with an overview of renewable energy technology and terminology, as well as the most practical way to regulate it while still providing a renewable-friendly market.

Renewable Energy in Character Areas

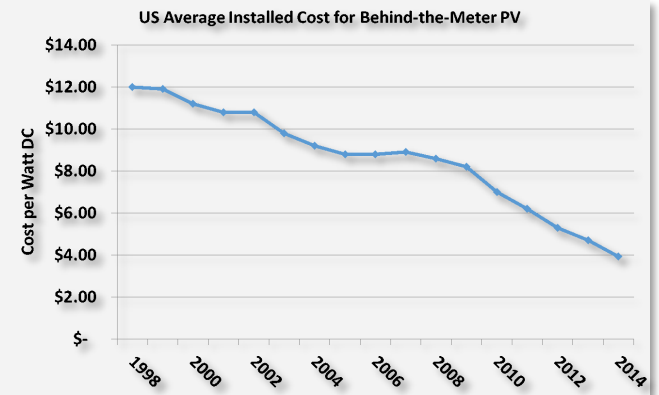
Growing Suburbs are frequently ideal for renewable energy systems. Large open areas can accommodate geothermal wells, ground-mounted solar, or even small wind systems. These areas can enhance their natural benefits by creating a favorable regulatory environment by establishing sensible, permissive regulations for renewables and streamlined permitting processes to encourage the renewable market.

Mature Neighborhoods can pose a challenge to the installation of renewables owing to the density of the building stock. Geothermal systems must usually be dug vertically, and there could be difficulty getting large boring equipment onto a small site. Similarly, it would be difficult to erect free-standing wind structures to the necessary height to avoid obstructions and access the strongest winds. Mature tree coverage can reduce the effectiveness of rooftop solar, and smaller, older buildings might not have enough roof area or appropriate underlying structures to support an adequately sized system. Still, there are a number of opportunities to be found in **Mature Neighborhoods** as well. Smaller buildings, particularly those built with a party wall such as twins, row homes, and connected blocks of retail, tend to be more energy efficient to begin with, meaning that a smaller renewable system would still have a significant impact on overall energy use. Additionally, a lot of the more urban development features flat roofs, which are ideal for solar installations.

SOLAR ENERGY

Solar photovoltaic (PV) systems convert sunlight into electricity. Each solar **panel** or **module** is made up of a number of solar **cells** that each produce power depending on how much sun is shining on it. Several panels wired together form an **array**, which can vary in size depending on the energy needs of the property. Solar cells produce direct-current (DC) electricity, so the solar system must include an **inverter** to convert it to alternating current (AC) to be used in the home or business, or sent out into the electric grid. Systems that are tied to the electricity grid will include disconnect switches to control the flow of power to the circuit or the grid in case of the need for system repair or an outage. Solar panels can either be **ground-mounted** or **roof-mounted,** depending on the available space, and are most productive when facing true south with full access to sunlight.

Solar is likely to be the most common technology that municipalities see being installed, largely due to increasing affordability. In the past five years alone the cost per watt of installing solar has dropped by more than half and continues to fall, even as governmental subsidies expire. Private companies are finding it profitable to lease roof area for solar panels, encouraging solar panel applications even among homeowners who may not be able to afford the up front costs of solar installations.



Meister Consulting Group


Rose Valley Borough — Solar States


Middletown Township — Solar States

FIRST RESPONDER SAFETY

First responder safety is of particular concern for roof-mounted solar, as the presence of a solar system can create an obstacle to first responders during a fire, as well as the fact that solar panels produce at least some electricity if light is shining on them. A lot of issues surrounding solar and first responder safety can be addressed with education and adequate preparation. Municipalities should work with their fire departments to make sure they know where solar systems are located, what size they are, where disconnect switches are located, and other such related concerns.

Regulatory Considerations:

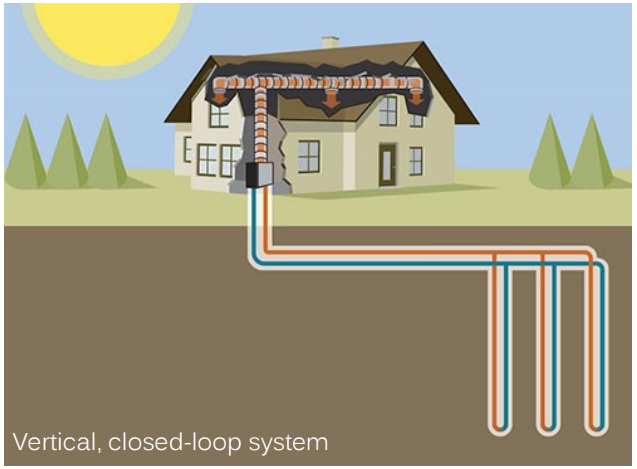
- Regulations should ensure that solar systems **allow roof access** around one or more perimeters of the roof, while not mandating too wide a pathway so as to restrict the area available for the solar system.
- Regulating the **aesthetics** of solar is not recommended. Because PV systems are designed to absorb light rather than reflect it, glare is minimal. Prohibiting solar on front elevations would restrict the ability of south-facing properties to install systems on the most effective roof surface. However, this restriction can be considered in regulated historic districts where integrity of the district is a major contributor to its character.
- **Removing trees** to install solar technology is generally not recommended despite the fact that shade interferes with solar energy systems' ability to operate. If tree removal is allowed, it is strongly recommended that replanting of an equivalency of lost trees/foliage be required in a solar ordinance.
- On **flat roofs**, allowances may need to be made in order to accommodate solar systems if the building is already at the regulated height limit. Given that solar systems often need to be tilted to achieve maximum efficiency, they may need to exceed height limits by several feet. On sloped roofs, the height of a the highest point of a solar system should not exceed the height of the ridgeline due to wind loading issues, so additional height allowances should not be necessary.
- **Ground mounted** solar systems are typically more expensive but may be accommodated when there is sufficient land. Municipalities typically regulate the setback of these systems from the property line as well as their height, as they would almost any other accessory structure. Overly-restrictive setback requirements could limit the available, unshaded space on the site suitable for a solar system. Additionally, some municipalities count the area or a fraction of the area of ground-mounted solar towards a site's impervious coverage totals, but this could be overly restrictive. Solar systems do not completely prevent water from running into the ground; therefore, as long as they are mounted over pervious surfaces, it should not be necessary.

Swarthmore Borough Solar States

GEOTHERMAL ENERGY

In its most common form, geothermal energy uses pipes that circulate water underground where the temperature is relatively constant to improve the efficiency of heating and cooling systems in buildings. Ten feet below the earth's surface, the temperature remains a relatively constant 50 to 60 degrees Fahrenheit. A geothermal or ground-source heat pump system (GHPS) consists of narrow **bore holes** containing **pipes** drilled into the ground, a **ground heat exchanger**, a **heat pumping unit**, and **ductwork** in the building. In the winter, heat from the warmer ground is transferred through the heat exchanger into the building. In the summer, the heat from the warmer building is transferred into the ground via the underground pipe system. Systems can consist of either a **vertical** or **horizontal** arrangement of pipes (depending on the available space and composition of the ground), and either utilize a **closed loop** system of circulating water or an **open loop** system when a surface- or ground-water source is available.

The geothermal market is relatively mature and has grown at a slow but steady rate in recent years. Geothermal is most cost effectively included in new construction areas with available land for horizontal systems. Despite its proven efficiency, it can be hindered by high up-front costs and therefore is not as common as solar.


Vertical, closed-loop system


Thermo Supply

Middlesex Township, Butler County


Thermo Supply

Middlesex Township, Butler County


Brington, Colorado

Colorado Geothermal Drilling

Regulatory Considerations:

- The decision to **require boring permits** for digging wells, including geothermal wells, is made on the municipal level. Pennsylvania is one of only two states in the country with no statewide regulations for construction of most wells or boreholes. Delaware County does not regulate well-drilling on the county level, although surrounding counties in the region, such as Chester and Bucks, do.
- Many ordinances establish **minimum isolation (setback) distances** from critical natural or water resources such as wetlands, lakes, and creeks, as well as from manmade water infrastructure such as storm drains, water and sewer lines, and septic tanks. Surface or underground hazards such as barnyards, fuel tanks, and cesspools should also be given adequate distance from geothermal bore holes. It is recommended that municipalities establish setbacks from property lines, building foundations, and public right-of-ways.
- **Maintenance and abandonment provisions** are common for regulations related to large systems like Geothermal.


Geothermal Heating and Cooling, INC

Saxonburg Borough, Butler County


Dillan Well Drilling

Darlington Borough, Beaver County


Madison, Wisconsin

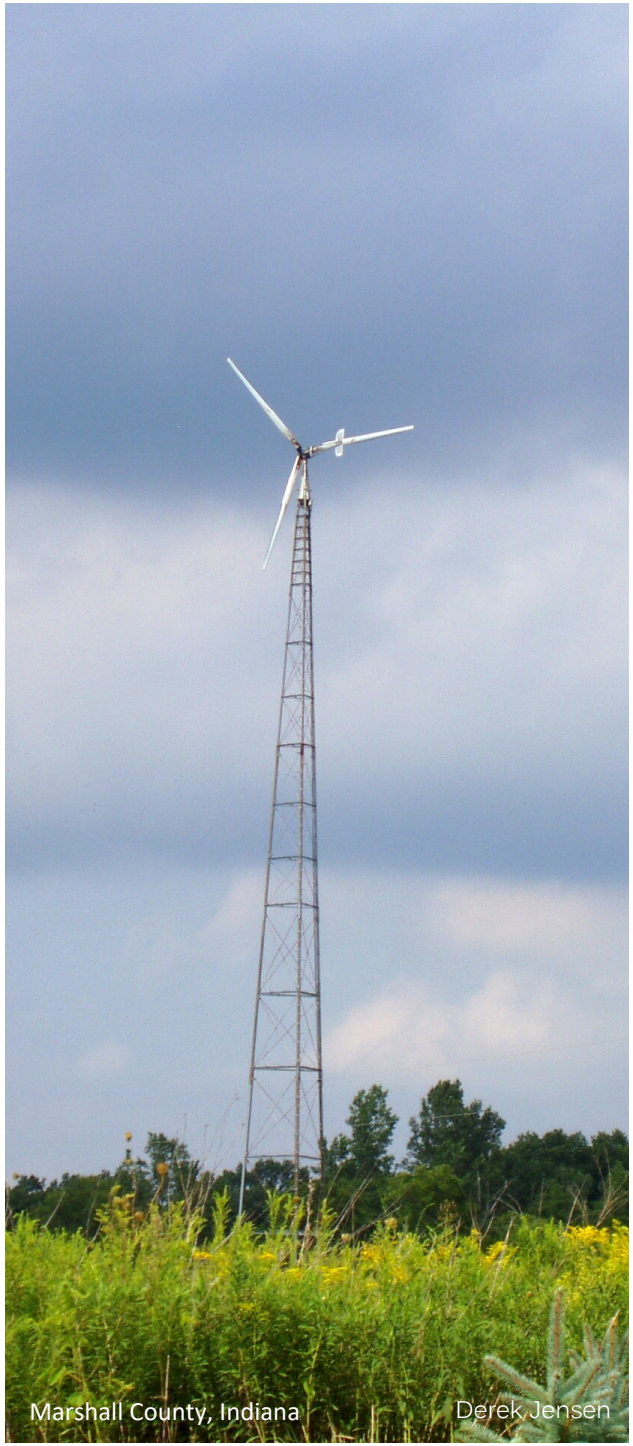
Terry Miller HVAC, llc

WIND ENERGY

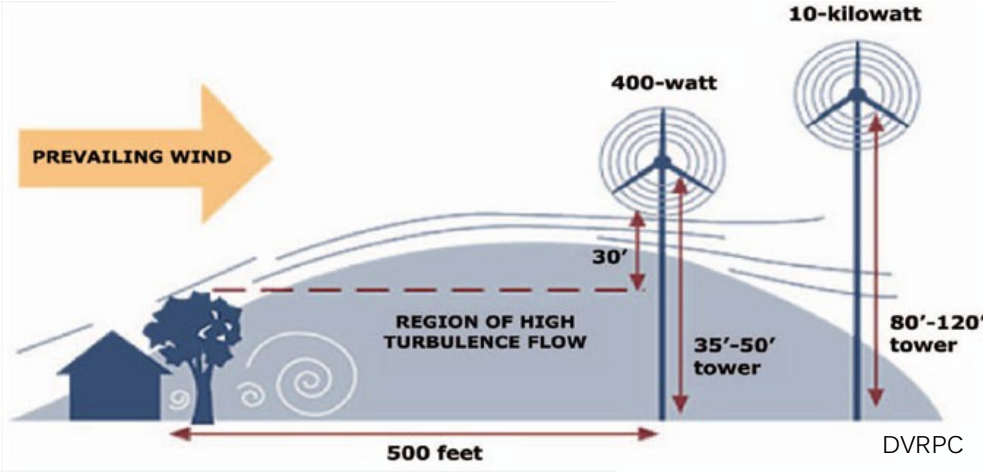
Small wind energy systems are most often used to provide supplemental power to residences or farms. A **turbine** mounted on a **tower** is powered by the wind to generate electricity. On the ground, the tower is mounted in a foundation and wiring connects the system to the electrical grid. Towers may need to be anywhere from 45 to 160 feet high depending on the size of the turbine and the local landscape and wind patterns. A typical residential-sized wind energy system ranges in size from five kW to 20kW, depending on the energy demand of the home, while a farm-scale application can reach up to 100kW. Actual generation is variable based on wind. Turbines can have either a **horizontal** or **vertical** axis, with horizontal axis being most common. The supporting tower can be a **free-standing monopole** (similar to a flag pole) or a **"guyed" tower**, which is usually a lattice tower with supporting guy wires. Small wind turbines can be **roof-mounted** or **building-integrated** rather than be on separate towers.

Small-scale wind is not as common in Delaware County due to of a lack of consistent wind resources and the required space for effective turbines. Residents and businesses are much more likely to purchase energy – through the deregulated utility market – from commercial-scale wind operations in rural areas than they are to attempt to generate their own energy through small wind systems. Still, municipalities may want to be prepared for wind installations from residents or businesses who wish to visibly show their support for renewable energy by installing wind systems.

US Department of Energy



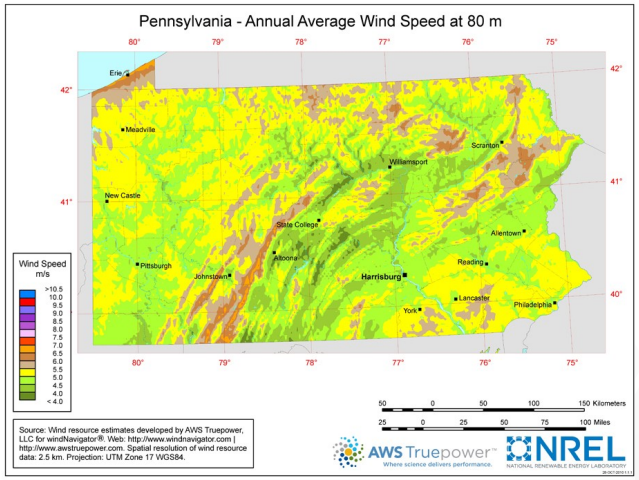
Marshall County, Indiana | Derek Jensen

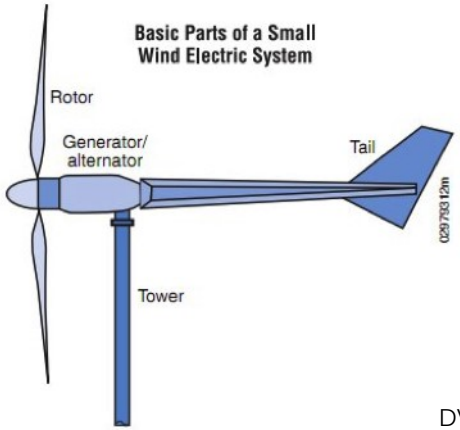


DVRPC

Regulatory Considerations:

- **Height restrictions** can have a negative impact on the effectiveness of wind systems. When an ordinance restricts heights to 30 to 60 feet, the potential output of the turbines may be compromised due to the fact that wind speeds and consistent wind quality increase with elevation, and turbines are more likely to be in the path of an obstruction or hit with turbulent winds at lower elevations.
- Proximity to **utility lines** is a concern unique to small wind energy systems.
- **Setbacks** for wind energy systems may be established based on absolute distance or distances relative to the height of the structure (e.g. 1.5 times the height of the structure). However, because wind energy systems must meet stringent structural requirements and are no more likely to tumble over than other man-made structures, excessive setbacks may not be necessary.
- **Aesthetic concerns** can be mitigated through restricting the use of advertisements, lighting, or obtrusive colorings on wind energy systems. Some municipalities also place restrictions on the type of tower allowed.
- Municipal **noise restrictions** to combat excessive noise and protect neighboring properties may not apply to wind energy systems because the ambient noise level of most small wind energy systems is approximately equivalent to that of a refrigerator.
- Regulations requiring that systems are designed so as not to **cast a shadow** on adjacent occupied structures may not be necessary. Shadow flicker – the phenomenon where the shadow of moving blades create a strobe effect on sunny days – is generally only a concern with large, utility-scale wind energy systems.
- **Maintenance and abandonment provisions** are common for large wind energy systems.





DVRPC

RESOURCES

General

- **DVRPC**'s *Renewable Energy Ordinance Frameworks* provide information on renewable energy technologies including solar, geothermal, and wind, as well as guidance on how to construct these renewable energy ordinances. http://www.dvrpc.org/EnergyClimate/AEOWG/
- **Edgmont Township** has established regulations and standards for renewable energy through ordinances regulating the construction of windmills, solar energy generation, and ground source heat pumps (geothermal). Township of Edgmont, PA Alternative Energy (ecode360.com)
- The US Department of Energy's **Office of Energy Efficiency and Renewable Energy (EERE)** leads a large network of researchers and other partners to deliver innovative technologies that will make renewable electricity generation cost competitive with traditional sources of energy. http://energy.gov/eere/renewables
- ConservationTools.org is managed by the **Pennsylvania Land Trust Association**. Their *Zoning for Non-Commercial Solar and Wind Systems* guide examines the issues surrounding these renewable systems. https://conservationtools.org/library_items/971-Zoning-for-Solar-and-Wind-Energy-Systems

Solar

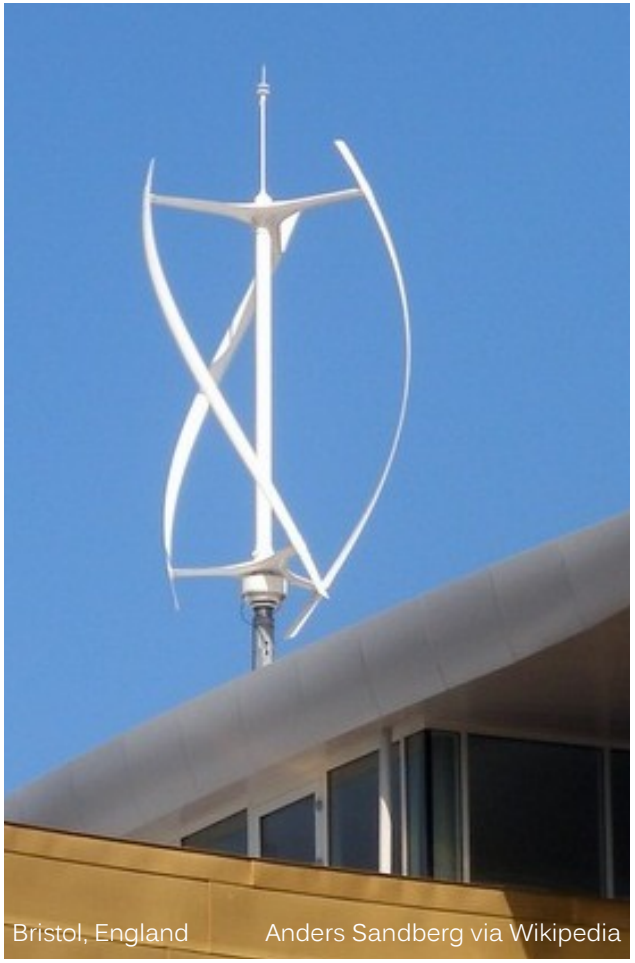
- *Solar Energy Systems: A Guide for Pennsylvania Municipal Systems* was published in 2009 by the **Department of Environmental Protection** and serves as a resource on solar energy technology and its relevant issues, as well as regulations for local municipalities in Pennsylvania. http://www.pennfuture.org/UserFiles/File/Energy/Solar_MuniGuide_200912.pdf
- **Meister Consultant Group** produced a guide to *Rooftop Solar PV & Firefighter Safety* that gives an overview of solar photovoltaic installations as well as major hazards and risks.
- The **City of Philadelphia** has a *Solar Energy Guide for Solar PV* that offers detailed methods for planning and implementing solar energy in both commercial and residential systems. https://alpha.phila.gov/documents/solar-energy-guides/
- The **American Planning Association**'s Planning Advisory Service provides an *Essential Info Packet on Planning and Zoning for Solar Energy*, including case studies, online guides, and model ordinances. https://www.planning.org/pas/infopackets/

Geothermal


Delaware County Courthouse, Media Borough


Media Borough Solar States

West Chester Eldredge Geo Solutions



Bristol, England Anders Sandberg via Wikipedia

- **Edgmont Township**'s Building Department Application includes geothermal borehole regulations (page 7), particularly on the location of the geothermal boreholes and the distance to any relevant features. https://edgmont.org/vertical/sites/%7B05006893-23B5-46CE-8F41-1CE251B86F61%7D/uploads/Building_Permit_Application_21-03-03.pdf
- The **Spring Creek Watershed Commission** out of State College has drafted a set of model well and borehole regulations for local municipalities. One draft can be used in conjunction with the Property Maintenance Code implemented by municipalities with in-house code inspection services. A second draft can be adopted as a stand-alone ordinance by those municipalities that do not have a Property Maintenance Code in effect. http://scwatershed.com/component/content/article/39-well-drilling/84-spring-creek-watershed-model-ordinance-for-borehole-and-well-drilling.html
- The **Pennsylvania Department of Conservation and Natural Resources (DCNR)** has general guidance on water well drilling and abandonment. http://www.dcnr.state.pa.us/topogeo/groundwater/gw_privwells/index.htm

Wind

- The **American Wind Energy Association (AWEA)** has resources and information on all types of wind energy, including small wind. http://www.awea.org/Resources/Content.aspx?ItemNumber=900
- The **AWEA** published a guide for state and local governments in 2008 titled, **In** *the Public Interest: How and Why to Permit for Small Wind Systems*. http://www.dvrpc.org/EnergyClimate/ModelOrdinance/Wind/pdf/AWEA_In_the_Public_Interest_2008.pdf
- The **Pennsylvania Wind Working Group** has a model ordinance for wind energy as well as other general resources. http://www.pawindenergynow.org/
- The **US Department of Energy's EERE** office published a *Small Wind Electric Systems Guide* for Pennsylvania consumers.

OTHER PLANNER'S PORTFOLIOS:

CHARACTER AREAS
March 2016

FUNDING SOURCES
April 2016

GREEN INFRASTRUCTURE
July 2016

Court House and Government Center
201 West Front Street
Media, Pennsylvania 19063

For more information, contact the Delaware County Planning Department at 610-891-5200 or visit https://www.delcopa.gov/planning/planningeducation.html to see the complete Planner's Portfolio series.