KENT COUNTY, MARYLAND

RENEWABLE ENERGY TASK FORCE

Established 9 March 2010

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Renewable Energy Task Force Charge

In 2008, Maryland adopted the Empower Maryland Act, which aims to reduce energy consumption 15% by 2015 and more than doubles Maryland's renewable portfolio standard to require that utilities purchase 20% of their power from clean energy sources by 2022. In 2009, Maryland established a new initiative to spur large-scale, commercial renewable energy projects in the state. Called "Generating Clean Horizons", Maryland is teaming up with county, university, and municipal partners to use their combined market power to jumpstart new commercial renewable energy projects. Toward this end, Maryland issued a Request for Proposals on May 21, 2009 offering long-term power purchase agreements to clean energy developers that can place renewable power on the grid in Maryland by 2014.

These statewide initiatives, along with additional federal incentives, create an opportunity for widespread development and use of alternative energy sources at the residential, commercial, and utility scale levels. While these incentives create great opportunities, renewable energy installation, particularly at the utility scale, also raises new siting and land use issues. The development of both renewable and non-renewable sources of energy presents specific challenges to the communities involved, including permitting and zoning of facilities and support industries, provision of appropriate infrastructure, and worker housing.

Therefore, in order for Kent County to address the opportunities and challenges presented by the development and use of clean renewable energy sources (such as solar, wind, geothermal, methane and biomass), the County Commissioners of Kent have created a Renewable Energy Task Force to study the potential uses of renewable energy in the county and recommend appropriate policies and ordinance amendments. Specifically, the Task Force is charged with the following:

- Objectively evaluate the application of each type of renewable energy technology at the residential, commercial, and utility scale for their benefits to the county and potential affects on the community and the environment

- Identify infrastructure requirements including those needed for transmission and the conversion from energy to electricity

- Advise the County Commissioners on the applicability of each type of technology to Kent County and recommend potential alternative energy technology that may be applicable to reduce county building or other structures energy use

- Propose appropriate policy changes and ordinance amendments

- Review current technology incentives

Renewable Energy Task Force Members

Walter Bowie	Village Representative
Elizabeth Beckley	Historic Preservation Commission Representative
William Cooper	Community Representative
Briggs Cunningham	Washington College Center for Environment & Society Representative
Ray Fenner	Community Representative
David Hill	Agricultural Advisory Commission Representative
Robert Ingersoll	Community Representative
Jay P. Lancaster	Planning Commission Representative
Eddie Taylor	Soil & Water Conservation District Representative
Ellyn Vail	Sassafras River Association Representative
Terry Willis	Upper Eastern Shore Tributary Strategies Team Representative
Gail Owings	Director Planning, Housing, and Zoning
Amy Moredock	Environmental Planner, Planning, Housing, and Zoning

Introduction

The Renewable Energy Task Force was established by the County Commissioners of Kent in March 2010. RETF members were appointed at the Commissioners regularly-scheduled Tuesday meeting on 9 March 2010 and held their first task force meeting on that day. Since then, the committee has met every other Friday morning at the R. Clayton Mitchell, Jr. Government Center at 9 am beginning in March 2010 and concluding their task in October 2010.

The RETF members decided initially to investigate each alternative energy system individually in terms of the following criteria:

- Background materials
- Feasibility
- Costs involved
- Maintenance
- Urban legends (facts v. misconceptions)
- Pros/cons
- Appropriate locations
- Siting
- Zoning (size, impact, residential v. commercial)

The systems were studied in this order: wind energy, solar energy, geothermal energy, and biomass. In addition to a considerable amount of background educational materials provided by both planning staff and RETF members, guest speakers addressed the committee when appropriate. Federal, state, and county documents were studied relative to existing and proposed alternative energy systems. In addition, a wide variety of resources were tapped in order to better-familiarize RETF members with alternative energy production and its impact on local communities (both positive and negative). Please see page Appendix C for a complete list of resources consulted.

In the following pages, the RETF will advise the County Commissioners on the applicability of each type of renewable energy technology to Kent County and will outline that technology's impact on a residential, commercial, and utility scale development as to their benefits to the county and potential affects on the community and the environment. The committee will identify infrastructure requirements for each alternative energy system including those needed for transmission and conversion from energy to electricity. In accordance with these findings, the RETF will propose appropriate policy changes and ordinance amendments.

Also included in this document are recommendations by the RETF outlining potential alternative energy technology that may be applicable to reduce energy costs in county buildings or other county-owned structures. This proposal will close with a review of current technology incentives and a list of resources that were consulted and may prove useful to both the County Commissioners and the residents of Kent County.

A driving force which focused the task force's investigation of each renewable energy system was clearly Kent County's Vision articulated in the Comprehensive Plan.

> Kent County is rich in agricultural, natural, cultural, and human resources. Quality soils, topography, climate, woodlands, the Chesapeake Bay with its tidal tributaries, wetlands, and marshes create an environment rivaled by few other areas. These natural features enrich our economy and the lives of our citizens. Kent County is also steeped in historic tradition. Towns and villages have a strong sense of identity, retaining their original design as a framework for their continuous and steady

development. From these singular resources and features emerged our local culture, character, and economy.

We are challenged, as we look to the future, to protect the quality of our environment and its inherent quality of life while meeting the needs of all our citizens. This special place has been purchased at a high cost, one of limited job opportunities, particularly for our young citizens. Although our economy has expanded from a chiefly farm-based and water-related one to one which includes industry, retail, tourism, and other service-oriented businesses, we must continue to seek innovative ways to diversify our economy and provide job opportunities for all Kent County citizens. Vigilantly safe-guarding those precious and irreplaceable resources unique to Kent County and wisely planning for change, we look forward to the challenge of the future.

The task force members recognize the County's vital resources in need of preservation noted in the Comprehensive Plan ranging from the Chesapeake Bay and its tributaries to the agricultural landscapes to the historic sites in the County. In addition, the RETF understands that the needs of its residents must also be considered. As it discussed each renewable energy system's pros and cons, the task force looked to the economic sustainability for the County and its residents as the balancing point with preservation. The members feel that the County is not a museum but a place where people live and work. Further, the RETF recognizes the need to promote sustainability and to move away from a dependency on traditional fossil fuels on a national level.

Finally, the RETF also acknowledges that, as the county and country looks to renewable energy resources, energy efficient building design should play an integral component, if not the cornerstone, of successful conservation efforts.

Wind Energy Systems

Discussion

The RETF members discussed wind energy systems during 6 meetings. This section captures the evolution and end result of that discussion. The members conducted a thorough review of wind energy ordinances from several Eastern and Western Shore counties (including but not limited to Baltimore, Howard, and Talbot Counties and the Town of Ocean City), as well as a review of the Maryland Model Wind Energy Ordinance; they also heard from two guest speakers. (See Appendix B Wind for a synopsis of guest speaker information.)

Windmills have been a part of Kent County's history since the mid-1800s. By converting wind power to mechanical energy, windmills were used for grinding grains into flour, to draw up water, as well as other uses. The modern-day windmill is more formally known as a wind turbine and is commonly used to convert the power of wind into electrical energy.

A wind energy system is also identified as a wind generator, wind energy system, wind power unit (WPU), wind energy converter (WEC), or aerogenerator. This report will use the term wind energy system.

Where there is sufficient steady wind, large commercial wind turbines can be arrayed in wind farms to provide renewable power for sale to the electrical grid. Commercial units can be as tall as 450 feet and generate large scale electrical output. However, the US Department of Energy's National Renewable Energy Laboratory rates the wind resources in Kent County as generally poor (Figure 1).

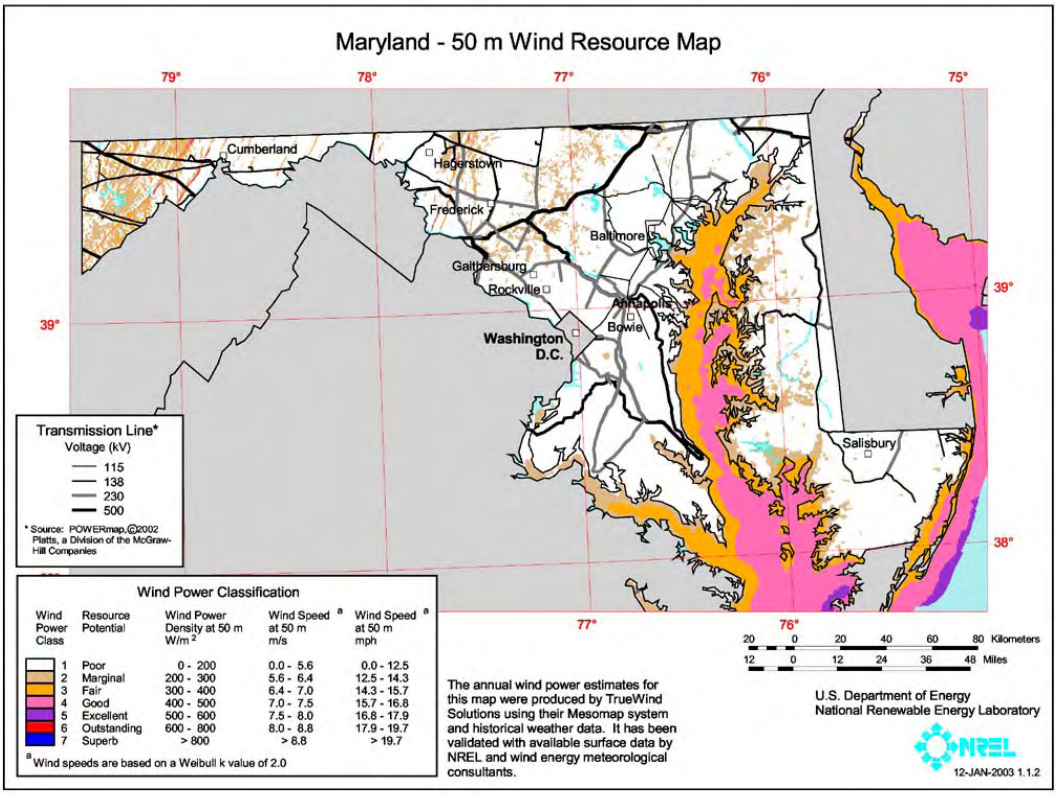


Figure 1: Maryland Small Wind Turbine Productivity Estimates

There does not appear to be sufficient wind in this area to justify utility scale wind farms, and for this and other reasons, the task force determined that utility scale wind energy is neither a feasible nor desirable use for Kent County. Rather, this report focuses on small wind turbine systems primarily used to offset the cost of electrical energy for individual homes or businesses. These systems have an electrical capacity of 100 k*ilowatts* or less. While these systems are generally connected to the electrical grid in some circumstances, they are not specifically intended to generate electricity for sale off site.

Kent County wind regulations
Currently, the Kent County Land Use Ordinance does not define small wind energy systems but does identify their use as permitted accessory structures. Consequently, the County has treated small wind energy systems as accessory residential uses with a maximum height of 45 feet. Identified in the Article VI, Section 3.2 (Supplementary height regulations), wind energy is guided by the following language (Amended 3 June 2008):

Windmills, private, residential less than 45 feet in height

A system proposed at a greater height would require variance from the height limit to allow installation. Several jurisdictions in Maryland have passed legislation to allow small wind energy systems. The legislative resources consulted by the task force come from these jurisdictions, as well as ordinances from other states.

This report will address the use of small wind energy systems on residential properties as well as other locations. As described later, small wind energy systems are becoming more prevalent throughout the country and their benefits are becoming increasingly apparent. Therefore, the RETF believes that small wind energy systems are appropriate as an a*ccessory use* in the County within certain parameters.

Considerations:
RETF members discussed the differences between commercial and residential energy production. The main distinction that the committee addressed dealt with *net metering*. *Net metering* (residential) is the term used to describe onsite energy creation that may qualify for a utility company credit. Net producing (commercial) utilizes multiple systems in which power is sold back to the grid. The committee moved forward by defining the parameters and quantifying how much energy is required to utilize wind energy onsite (n*et metering*/residential) versus how much energy is required to produce enough power to sell it for a profit (net producing/commercial).

It was decided that, in general, small wind energy systems can be a reliable and relatively inexpensive source of electricity. In addition to personal energy savings, the larger community could benefit through increased energy independence, reduced pressure on the local electricity grid, and the use of a clean energy source that will reduce the pollutants contributing to global warming. Because of these benefits, small wind energy systems are steadily increasing in number across the country and are beginning to appear in the County, as well.

However, with the lack of a steady energetic wind resource in this area, it is questionable if there will be a substantial demand for small wind energy systems. But, there may be certain areas or situations where use of wind energy will benefit the property owner. The Kent County Land Use Ordinance should allow for its use in these situations, while at the same time, ensuring that there will not be any unintended negative impacts for the property owner or the surrounding community. These potential negative impacts include safety, noise, visual aesthetics and danger to wildlife.

Safety: A number of safety precautions should be addressed for wind turbines. All components of a small wind energy system must be securely anchored and able to withstand high wind force. Electric Code in Maryland requires a manual and automatic shut off for private electricity production systems. To prevent turbine failure, turbines should be equipped with manual and automatic blade-breaking capability. For wind towers, the ability for an unauthorized person to climb up the structure should be minimized. Additionally, there should be ample room on the site to accommodate the tower in a horizontal position should it topple or need to be taken down for maintenance. Most ordinances from other jurisdictions require a setback equal to 110% of the tower height.

Danger to wildlife

In addition to the stability of the wind system system's structure, the RETF studied the turbine's impact on the County's avian population. The committee looked at a study of avian interactions with a wind energy system which was conducted over a 3-year period at Eastern Neck National Wildlife Refuge near Rock Hall, MD. The study revealed between 3-4 bird deaths occur annually as a result of the 60-foot wind turbine. In addition, birds nest in the turbine housing which results in the need for greater annual maintenance. Tower color and lighting are factors that also impact bird strikes. If a tower exceeds a particular height, it must have lighting in accordance with federal regulations. Based on this and additional information, the committee recommended that applicants be required to locate wind turbine systems outside of migratory pathways.

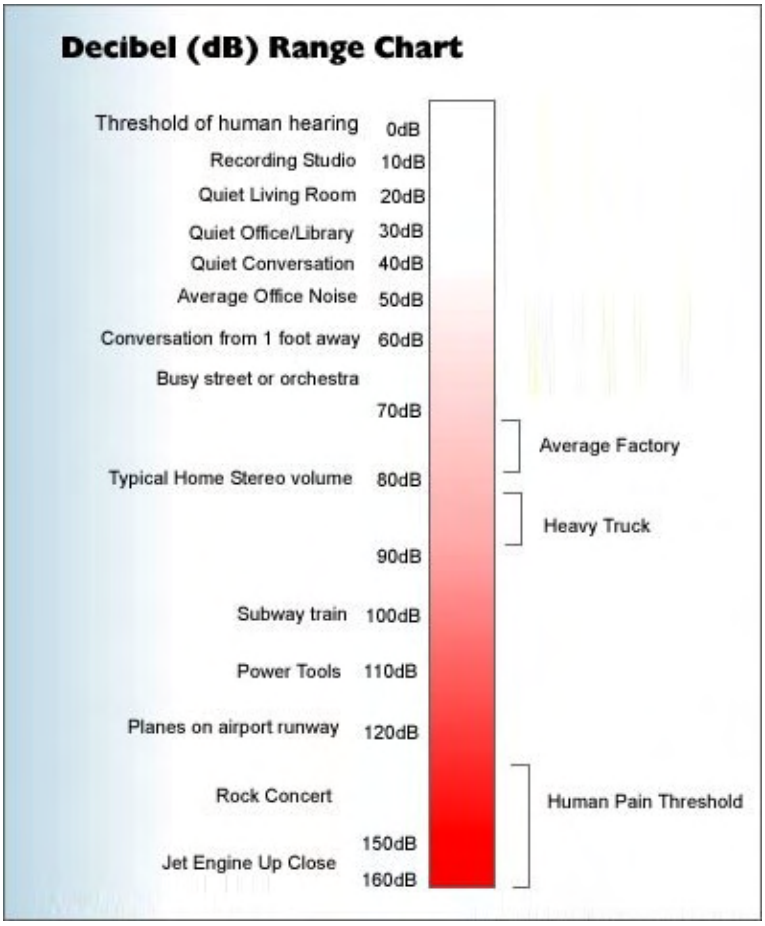


Figure 2: dB Range Chart

Noise: The RETF members studied the noise levels of both individual and large scale wind energy systems (residential vs. wind farm). The wind turbines manufactured today create less noise than those produced in the past. The typical wind turbine creates between 52-55 decibels or dB(A), which is equivalent to the noise of a humming refrigerator. The amount of noise created by a particular wind turbine will depend on the make of turbine, how much wind is present, and site conditions. Ambient noise levels found outdoors, which could include the sounds of traffic, dogs barking and rustling leaves, average 55 dB(A)—generally the same as wind turbines. While the noise level of a wind turbine is not usually louder than common background noise, the varying frequency of the turbine may become discernible from common background noises. The noise will usually decrease, and blend into the background noise, with increasing distance from the tower. Under certain circumstances, unique terrain and other site features may act to amplify the noise.

Visual aesthetics: Because of the height and clearance requirements of wind turbines, they are generally sited in very visible locations. Many people are concerned about visual clutter. While examining ordinances from other jurisdictions, the RETF learned that most provide limitations that reduce the potential for negative visual impact, including measures that limit color, reflectiveness, lighting and signage.

A light gray color is often recommended as a color that blends best into a background of sky. Most ordinances also require a large setback, generally for safety purposes, but this also helps to reduce the turbine's visual impact. Some also exclude wind turbines from areas where the visual character is especially important, such as historic districts or scenic preservation areas. Other regulations limit the number of wind turbines allowed on a property, or restrict the type to monopoles because of their more attractive, streamlined design, although some latticed poles may disappear into the background more readily. Some ordinances limit the height of wind turbines based on the use it is serving. For example in residential areas, the wind tower may be limited to a 10 kW capacity with an 80-foot tower.

In addition, the impact of flicker effect on neighboring properties was discussed.

The committee decided that, if a source of alternative energy other than wind can produce at least equal energy for a comparable cost and without greater environmental impact, then that source should be used rather than a tall tower which impacts the landscape. Likewise, lattice or monopole towers were preferable and guy wires should be prohibited.

RETF Recommendation:
The task force defined the following terms which apply to proposed zoning text amendments: small wind energy systems, shadow flicker, and MET tower. These terms as defined help to establish the parameters against which small wind energy system applications are to be reviewed. The task force felt that it was important to specify that energy production associated with a small wind energy system is to be used on site or to qualify for a utility company credit (aside from output delivered to a power grid to offset on site energy cost).

Following is a summary of the task force recommendations regarding small wind energy system uses:

- Permitted accessory uses on farms (properties comprised of 20 acres or more) in all districts except the Village District: Conditions of approval (9) were established some of which include an 80 foot height limit, setback requirements, and installation specifications relative to tip of blade, coloring, siting, signage, and consecutive use.
- Permitted accessory uses in the Commercial and Industrial districts (no acreage limit): Conditions of approval (9) were established some of which include an 80 foot height limit, setback requirements, and installation specifications relative to tip of blade, coloring, siting, signage, and consecutive use.
- A temporary MET tower of any height is permitted by right if it is erected for no more than 12 months, and all other standards are met in all Districts.
- *Special exception* in all residential and agricultural districts except the Village District with a height that exceeds 80 feet and not to exceed 120 feet on parcels less than 20 acres: Approximately 30 standards must be met in order to receive the s*pecial exception* for a wind energy system between 80 and 120 feet in height. These conditions range in nature from required wide range of impact studies to setback requirements, installation specifications relative to tip of blade, coloring, siting, signage, and consecutive use.
- *Special exception* in the Industrial District with a height that exceeds 80 feet and not to exceed 120 feet (no acreage limit): Approximately 30 conditions must be met to meet the s*pecial exception* standards. These conditions range in nature from required wide range of impact studies to setback requirements, installation specifications relative to tip of blade, coloring, siting, signage, and consecutive use.
- *Special exception* in the Village District with a height that exceeds 80 feet and not to exceed 120 feet (no acreage limit): Approximately 30 conditions must be met to meet the s*pecial exception* standards. These conditions range in nature from required wide range of impact studies to setback requirements, installation specifications relative to tip of blade, coloring, siting, signage, and consecutive use.

Wind Energy Systems: Proposed Land Use Ordinance Language

Definition:

Small Wind Energy System: A wind turbine mounted on a freestanding wind tower or building for the purpose of generating energy for use on site and not for sale and includes windmills that are used for pumping water or other purposes. However, the energy output may be delivered to a power grid to offset the cost of energy on site.

Shadow Flicker: A flickering shadow that is cast by a wind turbine's moving blade on a principal building and the area within 100' of the principal building on a neighboring or adjacent property.

MET Tower: A temporary tower erected for the purpose of performing a wind study to determine the optimal location for a wind energy system

Permitted Uses

Permitted Accessory Uses on farms in AZD, RCD, RC, RR, CAR, CR (All residential and agricultural districts except the Village District)

Small wind energy systems provided:

a) The height of the structure does not exceed 80 feet;
b) Any free standing structure is located a minimum of 1.5 times its total height from a property line;
c) Towers are not readily climbable from the ground up to 12 feet;
d) All access doors to towers and electrical equipment shall be lockable;
e) Appropriate warning signage is placed on the tower and electrical equipment;
f) The blade tip, at its lowest point has a ground clearance of at least 25 feet;
g) Wind turbines and towers maintain a galvanized steel, brushed aluminum finish, or a non-garish color;
h) Any small energy wind system that is not operational for a period of 12 consecutive months or more shall be removed at the landowner's expense.
i) Small wind energy systems shall be sited in a manner that does not result in significant shadow flicker impacts. Significant shadow flicker impact is defined as a flickering shadow that is cast by a wind turbine on a principal building and the area within 100' of the principal building on a neighboring or adjacent property for more than 30 hours per year.

Permitted Accessory Uses in the Commercial and Industrial districts

Small wind energy systems, limited to one tower, provided:

a) The height of the structure does not exceed 80 feet;
b) Any free standing structure is located a minimum of 1.5 times its total height;
c) Towers are not readily climbable from the ground up to 12 feet;
d) All access doors to towers and electrical equipment shall be lockable;
e) Appropriate warning signage is placed on the tower and electrical equipment;
f) The blade tip, at its lowest point has a ground clearance of at least 25 feet;
g) Wind turbines and towers maintain a galvanized steel, brushed aluminum finish or a non-garish color;
h) Any small energy wind system that is not operational for a period of 12 consecutive months or more shall be removed at the landowner's expense;
i) Small wind energy systems shall be sited in a manner that does not result in significant shadow flicker impacts. Significant shadow flicker impact is defined as a flickering shadow that is cast by a wind turbine on a principal building and the area within 100' of the principal building on a neighboring or adjacent property for more than 30 hours per year.

All Districts

A temporary MET tower of any height is permitted by right if it is erected for no more than 12 months, and all other standards are met.

Special exceptions

Special exception in AZD, RCD, RC, RR, CAR, CR (All residential and agricultural districts except the Village District)

Small wind energy systems with a height that exceeds 80 feet or on parcels less than 20 acres provided:

a) The applicant shall demonstrate that a source of alternative energy other than wind is not available that can produce at least equal energy for a comparable cost and without greater environmental impact.
b) If co-location with a personal wireless facility is proposed, then a need for the personal wireless facility tower must be documented and all appropriate studies submitted. In addition, the proposed tower must comply with all standards for both wind turbines and personal wireless facilities.
c) The applicant shall provide a report documenting that the wind energy system does not impact migratory bird pathways.
d) The wind energy system shall not be located within the air path of a private or public air strip.
e) The total height of the tower does not exceed 120 feet.
f) A small energy system shall not have more than one wind turbine per parcel.
g) Monopoles or lattice towers shall be the preferred tower structure in the County.
h) Guy wires are strictly prohibited.
i) Small wind energy systems may not be located within the buffer or within a stream protection corridor.
j) Small energy wind systems shall not be artificially lit unless such lighting is required by the Federal Aviation Administration.
k) Small energy wind systems shall be a galvanized steel, brushed aluminum finish, or a non-garish color or finish that conforms to the environment and architecture of the community, unless Federal Aviation Administration regulations require otherwise.
l) All sign,s including flags, streamers, and decorative items, both temporary and permanent, are prohibited on a small energy wind system except the manufacturer or installer's identification or appropriate warning signs or placards.
m) Any free standing structure is located a minimum of 1.5 times its total height from a property line.
n) Either towers are not readily climbable from the ground up to 12 feet or are fenced.
o) All access doors to towers and electrical equipment shall be lockable.
p) Appropriate warning signage is placed on the tower and electrical equipment.
q) The blade tip, at its lowest point has a ground clearance of at least 25 feet.
r) Any small energy wind system that is not operational for a period of 12 consecutive months or more shall be removed at the landowner's expense.
s) Small wind energy systems shall be sited in a manner that does not result in significant shadow flicker impacts. Shadow flicker impact is defined as a flickering shadow that is cast by a wind turbine on a principal building and the area within 100' of the principal building on a neighboring or adjacent property for more than 30 hours per year.
t) A small wind energy system, including wind turbine and tower, shall comply with all applicable construction and electrical codes.

u) Audible sound due to wind turbine operations shall not exceed 55 dB(A) except during short-term events such as utility outages and/or severe windstorms. The sound level shall be measured at ground level at the property line.
v) Any small wind energy system found to be unsafe shall be repaired by the property owner to meet these regulations and any applicable federal, state and local safety standards or be physically removed within 90 days.
w) The applicant shall demonstrate that a small energy wind system shall not unreasonably interfere with the view of, or from, sites of significant public interest such as public parks, a national or state designated scenic byway, a structure listed in the Kent County Historic Site's survey, an historic district, or of the Chesapeake Bay and its tributaries.
x) The following submittals are required for approval:
    i. Site plan, at a standard scale to adequately show:
        1. Property lines and dimensions of subject property
        2. Property lines and owner information for all abutting properties
        3. Locations of all existing buildings, structures, underground and overhead utilities on the subject property
        4. Locations of all existing buildings on abutting properties
        5. Location of the proposed small wind energy system with distances to show required setbacks
        6. Certification by a licensed professional engineer or property owner that the information shown on the site plan is accurate
        7. A shadow flicker study documenting compliance with shadow flicker impact definition per Article VII, Section 7.63.s
    ii. The small energy wind systems manufacturer's specification sheet, including photograph, sound analysis and mounting recommendations.
    iii. Engineering drawings showing the small energy wind system structure, including the tower, turbine, base, and footings, and an engineering analysis showing compliance with the International Building Code and certified by a licensed professional engineer. This analysis may be supplied by the manufacturer.
    iv. Siting elevations, existing photography, and a photo simulation from all directions.
    v. Any additional information as may be required by the Board of Appeals as appropriate, to demonstrate compliance with the regulations.
    vi. A narrative that explains how the site will not unreasonably interfere with the view of, or from, sites of significant public interest such as public parks, a national or state designated scenic byway, a structure listed in the Kent County Historic Site's survey, an historic district, or of the Chesapeake Bay and its tributaries.

Special exception in the Industrial District:
Small wind energy systems with a height that exceeds 80 feet provided: Same conditions as above

Special exception in the Village District:
Small energy wind systems in the Village District provided: Same conditions as above

Solar Energy Systems

Discussion

The RETF members discussed solar energy systems during 6 meetings. This section captures the evolution and end result of that discussion. Unlike wind energy systems which prompted many jurisdictions to address parameters of small and utility scale use through ordinances, solar energy systems are as not commonly addressed in local codes. The task force reviewed a Solar Access Guide produced by the City of Boulder, Colorado and design guidelines from the American Planning Association's *Zoning Practice*. In addition, a solar panel installer Robert Busler addressed the committee (See Appendix B: Solar for a synopsis of guest speaker information and background information).

Considerations

There was very little model solar energy language available from Maryland counties for the RETF to consider. Therefore, the committee built its dialogue from the manner in which they studied wind energy in the previous weeks, beginning with an examination of residential use versus utility scale use of solar energy technology.

The committee set about defining the parameters of each type of system. Commercial, or utility scale, systems were established as those containing any device or combination of devices or elements which rely upon direct sunlight as an energy source, including but not limited to any substance or device which collects sunlight for generating energy primarily for use off site. It was also decided that the energy generated by this system could be used to serve on site power needs.

Residential systems were defined as those containing a device or combination of devices or elements which rely upon direct sunlight as an energy source, including but not limited to any substance or device which collects sunlight for generating energy or heating hot water for use on site. However, the energy output could be delivered to a power grid to offset the cost of energy on site.

Notably, the committee quickly came to a consensus on utility scale solar energy, deciding that it should be permitted in the Industrial with clear standards and site plan review.

RETF members discussed the land available in the Industrial District (approximately 1,100 acres) and its main geographic concentration in the County which is located along the Route 301 corridor adjacent to Massey (with additional areas in Worton and near Chestertown). While the committee felt that utility scale solar energy was an appropriate use of that land, they remained concerned about the availability of land zoned Industrial for other desirable permitted uses. Therefore, the RETF decided that only 50 percent of land zoned Industrial should be used to accommodate solar power. Once 25 percent of the land zoned Industrial is occupied by solar energy systems, the County should be directed to re-evaluate this policy.

The committee heard a presentation on the use of solar panel arrays designed to provide electricity to chicken houses. Members agreed that small solar energy systems should be permitted accessory uses on farms. However, members were divided on locating utility scale solar energy systems in the Agricultural district. It was ultimately decided that, with clear conditions, utility scale solar energy systems should be permitted as s*pecial exceptions* in not only the Industrial but also the Agricultural, Commercial, and Commercial Critical Area zoning districts on a limited scale.

Solar Easements

The RETF discussed solar easements and issues of solar access involve neighboring air space, including the height and setback of adjacent buildings and trees. Solar easements seek to create adequate protections for property owners who install solar energy systems while not creating hardships for adjacent property owners. The RETF decided that the County should not adopt solar access protection provisions but rather encourage property owners installing solar energy systems to coordinate with adjoining property owners to obtain solar access protection.

Figure 3: Solar Panel

Safety

The committee discussed fire safety and emergency response issues for solar energy systems. It was decided that an emergency shut off mechanism should be required and notice of its location should be submitted to emergency services.

Visual Aesthetics

Mindful of keeping the balance between the promotion of solar energy systems and the preservation of the County landscape, the RETF decided that, while roof-mounted systems should be permitted as accessory uses or as s*pecial exceptions*, towers should be more closely reviewed. A roof mounted system must meet zoning district height requirements and not extend more than 10 feet from the top of the roof.

To further address aesthetics, the committee established that a solar collection device or combination of devices should be designed and located to avoid glare or reflection onto adjacent properties and roadways and shall not interfere with traffic or create a safety hazard. Also, screening, capable of providing year-round screening, should be provided along all sides of the system that do not actively collect energy.

Kent County solar regulations

Currently, the Land Use Ordinance does not address solar energy panels or systems directly. The few applications that have been submitted to the County for solar panels have been treated as uses customarily accessory to primary uses, such as a single family dwelling or an agricultural operation. All setback and height restrictions in each zoning district would apply to a solar panel/system application. Commercial/utility scale systems are not permitted.

RETF Recommendation:

The task force defined the following terms which apply to proposed zoning text amendments: small solar energy systems and commercial solar energy systems. These terms as defined help to establish the parameters against which small and large solar energy system applications are to be reviewed. The task force felt that it was important to specify that energy production associated with a small solar energy system is to be used on site or to qualify for a utility company credit (aside from output delivered to a power grid to offset on site energy cost).

Following is a summary of the task force recommendations regarding solar energy system uses:

- Permitted Uses, Utility Scale, in the Industrial and Employment Center Districts: Conditions of approval (5) were established to include installation and design specifications which reduce impact on neighboring properties, height limit set at 10 feet above top of roof and set by zoning district (45 foot limit), and registration with the Department of Emergency Services. Site plan review is required.
- Permitted Uses, Small Scale, in Commercial and Commercial Critical Area: Conditions of approval (5) were established to include installation and design specifications which reduce

impact on neighboring properties, height limit set at 10 feet above top of roof and set by zoning district (45 foot limit), and registration with the Department of Emergency Services. Site plan review is required.

- Permitted Uses/*Special Exception*, Utility Scale, in Agricultural and Resource Conservation Districts: Conditions of approval (13) were established to include installation and design specifications which reduce impact on neighboring properties and sites of significant public interest, height limit set at 10 feet above top of roof and set by zoning district (38 foot limit), and registration with the Department of Emergency Services. In addition, the solar collection system shall be incidental to the use of the farm with no alteration of utility infrastructure to accommodate system. Area of use may not exceed 5 acres onsite with no aggregation of solar collection panels on adjacent properties which exceed 5 acres. Area developed by utility scale solar energy system is considered development and counted toward the maximum percentage of the property in lots. Site plan review is required.
- Permitted Uses/*Special Exception*, Utility Scale in Commercial and Commercial Critical Area Districts: Conditions of approval (6) were established to include installation and design specifications which reduce impact on neighboring properties and sites of significant public interest, height limit set at 10 feet above top of roof and set by zoning district (45 foot limit), and registration with the Department of Emergency Services. Site plan review is required.
- Permitted Accessory Uses, Small Scale, in Industrial District: Conditions of approval (5) were established to include installation and design specifications which reduce impact on neighboring properties, height limit set at 10 feet above top of roof and set by zoning district (45 foot limit), and registration with the Department of Emergency Services.
- Permitted Accessory Uses, Small Scale, in Agricultural, Resource Conservation, Rural Character, Rural Residential, Critical Area Residential, Community Residential, Village, and Marine Districts: Conditions of approval (3) were established to include a restriction on tree removal, registration with the Department of Emergency Services, and a height limit established by zoning district.

Solar Energy Systems: Proposed Land Use Ordinance Language

Definitions:

Solar Energy System, Utility Scale*:* Any device or combination of devices or elements which rely upon direct sunlight as an energy source, including but not limited to any substance or device which collects sunlight for generating energy primarily for use off-site. Energy generated may be used to serve on site power needs.

Solar Energy System, Small: Any device or combination of devices or elements which rely upon direct sunlight as an energy source, including but not limited to any substance or device which collects sunlight for generating energy for use onsite. However, the energy out put may be delivered to a power grid to offset the cost of energy on site.

Permitted Uses

Solar Energy Systems, Utility Scale in EC and I provided:

a) A solar collection device or combination of devices are designed and located to avoid glare or reflection onto adjacent properties and adjacent roadways and shall not interfere with traffic or create a safety hazard.
b) Screening, capable of providing year round screening, is provided along the non-reflective axis of the solar collection device or collection of devices.
c) Roof mounted solar collection devices shall not extend more that 10 feet from the top of the roof. The total height of the building including the solar collection devices shall comply with the height regulations.
d) Solar collection devices shall not exceed 45 feet in height.

e) All solar collection devices shall register with the Department of Emergency Services and shall submit a map noting the location of the solar collection devices and the panel disconnect.

Solar Energy Systems, Small in C and CCA provided:

a) A solar collection device or combination of devices are designed and located to avoid glare or reflection onto adjacent properties and adjacent roadways and shall not interfere with traffic or create a safety hazard.
b) Screening, capable of providing year-round screening, is provided along all sides that do not collect energy.
c) Roof mounted solar collection devices shall not extend more that 10 feet from the top of the roof. The total height of the building including the solar collection devices shall comply with the height regulations.
d) Solar collection devices shall not exceed 45 feet in height.
e) All solar collection devices shall register with the Department of Emergency Services and shall submit a map noting the location of the solar collection devices and the panel disconnect.

Special exceptions

Solar Energy Systems, Utility Scale on farms in the AZD and RCD provided:

a) A solar collection device or combination of devices are designed and located to avoid glare or reflection onto adjacent properties and adjacent roadways and shall not interfere with traffic or create a safety hazard.
b) Screening, capable of providing year-round screening, is provided along all sides that do not collect energy.
c) Roof mounted solar collection devices shall not extend more that 10 feet from the top of the roof. The total height of the building including the solar collection devices shall comply with the height regulations established for each zoning district.
d) Solar collection devices shall not exceed 38 feet in height.
e) The solar collection system shall be incidental to the use of the farm.
f) Installation of the solar collection system shall not adversely impact adjacent properties.
g) All structures associated with the solar collection system shall be neither visually intrusive nor inappropriate to their setting.
h) All solar collection devices shall register with the Department of Emergency Services and shall submit a map noting the location of the solar collection devices and the panel disconnect.
i) Other than wire size, there shall be no alteration of utility infrastructure to accommodate system.
j) Area of use may not exceed 5 acres onsite. Adjacent properties shall not aggregate solar collection panels to achieve an area exceeding 5 acres.
k) In AZD, area developed by utility scale solar energy system is considered development and counted toward the maximum percentage of the property in lots.
l) Tree removal shall be minimized and any removal shall be mitigated in accordance with the Critical Area program requirements.
m) The applicant shall demonstrate that a utility solar energy system shall not unreasonably interfere with the view of, or from, sites of significant public interest such as public parks, a national or state designated scenic byway, a structure listed in the Kent County Historic Site Survey, an historic district, or of the Chesapeake Bay and its tributaries.

Solar Energy Systems, Utility Scale in C and CCA provided:

a) A solar collection device or combination of devices are designed and located to avoid glare or reflection onto adjacent properties and adjacent roadways and shall not interfere with traffic or create a safety hazard.
b) Screening, capable of providing year-round screening, is provided along all sides that do not collect energy.
c) Roof mounted solar collection devices shall not extend more that 10 feet from the top of the roof. The total height of the building including the solar collection devices shall comply with the height regulations.
d) Solar collection devices shall not exceed 45 feet in height.
e) All solar collection devices shall register with the Department of Emergency Services and shall submit a map noting the location of the solar collection devices and the panel disconnect.
f) The applicant shall demonstrate that a utility solar energy system shall not unreasonably interfere with the view of, or from, sites of significant public interest such as public parks, a national or state designated scenic byway, a structure listed in the Kent County Historic Site Survey, an historic district, or of the Chesapeake Bay and its tributaries.

Permitted Accessory Uses

Solar Energy Systems, Small in I provided:

a) A solar collection device or combination of devices are designed and located to avoid glare or reflection onto adjacent properties and adjacent roadways and shall not interfere with traffic or create a safety hazard.
b) Screening, capable of providing year round screening, is provided along the non-reflective axis of the solar collection device or collection of devices.
c) Roof mounted solar collection devices shall not extend more that 10 feet from the top of the roof. The total height of the building including the solar collection devices shall comply with the height regulations.
d) Solar collection devices shall not exceed 45 feet in height.
e) All solar collection devices shall register with the Department of Emergency Services and shall submit a map noting the location of the solar collection devices and the panel disconnect.

Solar Energy Systems, Small in the AZD, RCD, RC, RR, CAR, CR, V, M provided:

a) Tree removal shall be minimized and any removal shall be mitigated in accordance with the Critical Area program requirements.
b) All solar collection devices shall register with the Department of Emergency Services and shall submit a map noting the location of the solar collection devices and the panel disconnect.
c) The total height of solar collection systems shall comply with the height requirements.

Geothermal Energy Systems

Discussion

The RETF members discussed geothermal energy systems during 4 meetings. This section captures the evolution and end result of that discussion. The committee reviewed Maryland Department of the Environment permit requirements, as well as a several current policy articles on geothermal energy. In addition, geothermal system installers Jason Pinder and Michael Piposzar addressed the committee (See Appendix B: Geothermal for a synopsis of guest speaker information and background information).

Considerations

Like solar energy systems, there was very little model geothermal energy language available from Maryland counties for the RETF to consider. Therefore, the committee established a working definition of a geothermal system as one which relies upon heat stored within the earth as an energy source for use onsite. Property owners commonly refer to this type of system as a heat pump. The committee also examined the types of systems currently available for installation: closed and open loop systems. While both wind and solar energy systems have both utility scale and small scale applications in Kent County, the committee found that a utility scale use for geothermal energy had no real practical application in the County. It was decided that the impacts and ramifications of a large, utility scale geothermal system are still an unknown. The committee suggested that utility scale geothermal systems and technology should be revisited during the next Land Use Ordinance update.

Safety

The committee discussed the impacts of propylene glycol, ethylene glycol, and alcohol as components of open and closed loop geothermal systems. There are three types of closed loop systems: horizontal, vertical, and coiled. Further, the RETF discussed the chemicals used in such systems and their impact on the water table. While the members recognized that the piping is closed in these systems and is comprised of non-corrosive polyurethane pipe, they remained concerned about potential pipe damage and the subsequent leaking of chemical agents into the water table. The committee felt that a spill mitigation plan should be required with the installation of a geothermal system. The County would enforce and retain spill mitigation plans for geothermal systems. Such plans at present are not required by MDE; however, well regulations are currently being revised by the state. The County can be, and often is, more restrictive than the State. The RETF recommends this restriction.

The RETF decided that, while only closed loops systems should be permitted as accessory uses in most districts, open loop systems may be appropriate for agricultural use if there is an onsite agricultural need for the water (e.g., watering herds). The committee felt that no chemicals should be permitted within an open loop system. Further, chemicals such as propylene glycol and alcohol as components of the geothermal systems in closed loop systems may be appropriate.

Kent County geothermal regulations

Currently, the Land Use Ordinance does not address geothermal energy systems directly. To date, applications for the installation of geothermal systems have been reviewed by the Kent County Department of Environmental Health as a part of the well permit review but are not reviewed by the Planning Department.

RETF Recommendation:
The committee defined the small geothermal energy systems as any device or combination of devices or elements which relies upon direct heat stored within the earth as an energy source for use onsite. As with both wind and solar energy systems, the task force felt that it was important to specify that energy production associated with a small geothermal energy system is to be used on site.

The task felt that small geothermal energy systems should be permitted in all zoning districts with 2 conditions. One condition establishes specific provisions of open loop systems for agricultural use. The other condition establishes a spill mitigation plan requirement.

Geothermal Energy Systems: Proposed Land Use Ordinance Language

Definition:
Geothermal Energy System, Small: Any device or combination of devices or elements which relies upon direct heat stored within the earth as an energy source for use onsite.

Permitted Accessory Uses
Geothermal Energy Systems, Small provided:

a) The geothermal energy system must be a closed-loop system (horizontal, vertical, or slinky); or an open loop system which includes provisions for agricultural use in AZD and RCD if there is an onsite agricultural need for the water (e.g., watering herds). No chemicals shall be permitted within an open loop system.
b) A spill mitigation plan shall be required if toxic chemicals are used in the system.

Biomass Energy Systems

Discussion

The RETF members discussed biomass energy systems during several meetings. This section captures the evolution and end result of that discussion. The committee reviewed Maryland Department of the Environment permit requirements, as well as a several current policy articles on biomass energy.

Considerations

Like solar energy systems, there was very little model biomass energy system language available from Maryland counties for the RETF to consider. The committee discussed definitions and applications of biomass (liquidation, burning, pelletizing). The members were careful to consider existing indoor and outdoor wood burning stoves and furnaces when defining biomass energy systems and the conditions associated with them. While the committee was inclined to allow small scale biomass energy systems for uses onsite as an a*ccessory use* in all zoning districts, it was decided that the impacts and ramifications of a large, utility scale biomass system are still unknown. The technical details of the biomass systems continue to evolve. Therefore, the committee suggested that utility scale biomass energy systems and technology should be revisited during the next Land Use Ordinance update.

Safety

The committee discussed the possible impacts on the environment, including noise, vibration, smoke and particulate matter, toxic matter, odor, fire or explosion hazards, or glare. In addition, the RETF decided that a waste management plan should be implemented. The County would enforce and retain these plans. Such plans are not required by Maryland Department of the Environment. The County can be, and often is, more restrictive than the State. The RETF recommends this restriction.

Kent County biomass regulations

Currently, the Land Use Ordinance does not address biomass energy systems directly. To date, applications for the installation of such systems have been reviewed by the Kent County Department of Environmental Health but are not reviewed by the Planning Department.

RETF Recommendation:
The committee defined small biomass energy systems as any device or combination of devices or elements which use biological material from living or recently living organisms (including but not limited to wood, waste, methane gas, and alcohol fuels) to generate electricity or produce heat for use onsite. As with both wind and solar energy systems, the task force felt that it was important to specify that energy production associated with a small biomass energy system is to be used on site.

The task force felt that small biomass energy systems should be permitted in all zoning districts with 3 conditions. One condition establishes specific provisions regarding location and construction standards. The second condition addresses the impact of the system on neighboring properties, and the final condition establishes a waste management plan requirement.

Biomass Energy Systems: Proposed Land Use Ordinance Language

Definition:
Biomass Energy System, Small: Any device or combination of devices or elements which use biological material from living or recently living organisms (including but not limited to wood, waste, methane gas, and alcohol fuels) to generate electricity or produce heat for use onsite.

Permitted Accessory Uses
Biomass Energy Systems, Small in the all zoning districts provided:

a) The system shall be installed and maintained in accordance with applicable location and construction standards of the County, State, and Federal agencies;
b) The applicant shall address the impact of probable effect of noise, vibration, smoke and particulate matter, toxic matter, odor, fire or explosion hazards, or glare associated with the system upon surrounding properties; and
c) A waste management plan shall be implemented.

Recommendations for Kent County Properties

The following are recommendations generated by the task force to reduce energy consumption in County buildings and structures or to promote awareness of alternative energy resources within the community:

- Investigate the feasibility of solar energy system installation at the following county sites:
  - Wastewater treatment plants and pumping stations
  - Public Works Facility on Morgnec Road to provide enough electricity to power that facility. The southwest corner of the property is an appropriate location for solar panels.
  - Worton Community Center
  - All county schools
  - Existing county buildings
  - New construction (consider installing both geothermal and solar energy)
  - Roof maintenance and/or replacement on county buildings
- Promote the implementation of alternative energy curriculum in the County schools.
- Consider establishing a connection between area tradesmen and the Board of Education in order to invite input and demonstrations from area experts into the vocational curriculum.
- Continue to investigate the feasibility of using biodiesel fuel in all county vehicles.
- Compile and aggressively communicate to all county residents the federal, state, and local incentives for using alternative energy sources (see page 24).
- Seek grant funding to retrofit County buildings with alternative energy systems.
- Complete and implement the findings of an energy audit on all County buildings.
- Implement the conservation practices identified in the Kent and Queen Anne's County Early Action Compact.
- Investigate a program for low interest loans (revolving fund) for alternative energy installation.
- Hold a renewable energy fair.
- Provide training opportunities for interested local contractors regarding alternative energy system installation.

State and Federal Renewable Energy Incentives

General information related to renewable energy incentives

- Renewable Energy Brochure: Incentives of Residents and Businesses in Maryland (http://energy.maryland.gov/documents/RenewableEnergyResources.pdf)

County Incentives

- The Maryland Energy Administration offers no specific incentives for Kent County, but does offer incentives for Anne Arundel, Howard, Hartford, Montgomery, and Prince George's Counties which may be accessed at http://energy.maryland.gov/incentives/residential/CountyIncentives.asp.

State Incentives

The Maryland Energy Administration offers the following state incentives which may be accessed at http://energy.maryland.gov/incentives/residential/:

- Database for state incentives for renewables and efficiency: http://www.dsireusa.org/incentives/index.cfm?re=1&ee=1&spv=0&st=0&srp=1&state=MD
- Solar Renewable Energy Certificates (SRECs): http://www.srectrade.com/maryland_srec.php
- Incentives Farm Energy Audit Program: Provides qualifying farmers energy audits and installation incentives
- Bio-Heating Oil Tax Credit Program: An incentive of $0.03/gallon up to $500
- Geothermal Heat Pump Grants: Up to $10,000 to install qualified geothermal heat pumps in homes and businesses
- Solar Grants: Funding of up to $10,000 to install qualified solar energy systems in homes and commercial buildings
- Wind Alternating Current Loans: MEA is loaning wind measuring devices to landowners for up to one year to determine the economic feasibility of installing a wind turbine
- Clean Energy Production Tax Credit - Initial Credit Certificate: The Clean Energy Incentive Tax Credit offers Marylanders a state income tax credit for electricity generated by qualified resources
- Windswept Grant Program: The Windswept Grant Program will help offset a portion of the cost of small scale wind energy projects

Federal Incentives

- Tax Incentives Assistance Project (http://energytaxincentives.org/): On February 21, the U.S. Treasury Department and the Internal Revenue Service (IRS) released "Guidance Notices" on claiming tax incentives for energy efficiency improvements to existing homes.
- United States Department of Energy (http://www.energy.gov/taxbreaks.htm): Federal home energy efficiency improvement tax breaks for home upgrades.
- Solar Energy Industries Association (http://www.seia.org/cs/american_recovery_and_reinvestment_act): established in 1974, this organization promotes awareness of solar energy technologies and posts available federal and state incentive links.

Appendix A: Glossary

Accessory use - one which: (a) is subordinate to and serves a principal structure or principal use; (b) is subordinate in area, extent, and purpose to the principal structure or use served; (c) is on the same lot as the principal structure or use served except as otherwise expressly authorized by provisions of this ordinance; and (d) is customarily incidental to the principal use or structure.

Alternating Current (AC) - a continuous electric current that periodically reverses direction (usually sinusoidally).

Anemometer - an instrument that measures the speed of the wind or of another flowing fluid. The most basic type of *alternating current* consists of a series of cups mounted at the end of arms that rotate in the wind. The speed with which the cups rotate indicates the wind speed.

Direct Current (DC) - a continuous electric current that flows in one direction only without substantial variation in magnitude.

Inverter - An electronic device that reverses the sign of the current or voltage of a signal or power source (also called phase *inverter*). An electrical device used to convert *direct current* into *alternating current*.

Kilowatt - a unit of power equal to 1,000 watts (or 1,000 joules per second).

Kilowatt hour - a unit of energy equivalent to one *Kilowatt* of power expended for one hour of time.

Megawatt - a unit of power equal to one million watts (one million joules per second).

Net metering (residential) - a utility resource meant for onsite usage of energy creation which incorporates a payment scheme in which a customer who generates his own power is compensated monetarily or acquires utility company credit for onsite energy creation.

Solar south – The direction of the sun at solar noon on any given day, as opposed to magnetic south. The s*olar south* takes into consideration the sun's path.

Special exceptions - certain uses, which because of their unique characteristics cannot be distinctly listed as a permitted use in a particular District. These s*pecial exceptions* may be approved by the Board of Zoning Appeals, or where applicable the Planning Director, after consideration in each case of the impact of such uses upon neighboring uses, the surrounding area and the public need for the particular use at the particular location. Limitations and standards are herein established to ensure the use's consistency with the character, uses and activities in the District.

Abbreviations

Decibels	dBA
Kilowatt	kW
Kilowatt hour	kWh
Horizontal Axis Wind Turbine	HAWT
Photo voltaic	PV
Renewable Energy Task Force	RETF
Vertical Axis Wind Turbine	VAWT

Zoning Districts

Agricultural	AZD
Commercial	C
Commercial Critical Area	CCA
Community Residential	CR
Critical Area Residential	CAR
Crossroads Commercial	CC
Employment Center	EC
Industrial	I
Industrial Critical Area	ICA
Intense Village	IV
Resource Conservation	RCD
Rural Character	RC
Rural Residential	RR
Village	V

Appendix B: Background Information for Wind Energy

Guest Speakers:
Betsy Kulman, an environmental journalist producing and writing for CNN, the Weather Channel, and ABC, shared the following information regarding her experience covering an Ontario Wind Farm. The wind farm was of utility scale consisting of over 65 wind turbines, each as tall as a 25-story building. Ms. Kulman discussed the negative effects of a large wind farm to include noise, flicker effect, homeowner exodus, bird deaths, and lighting. She noted that the payback was big for the business and negligible for the neighbors. Listening to Ms. Kulman's experience, while limited to one very large wind farm, assured the RETF that utility scale wind energy was not an appropriate fit for Kent County.

In addition, Andrew Gohn of the Clean Energy Program Manager at Maryland Energy Administration addressed the following topics with the committee:

- Identified nearly 10 counties in Maryland which are in the process of or have adopted Wind Energy Ordinances
- National Renewable Energy Laboratory (NREL) has published 50-meter wind maps on the state and nationwide levels designed to provide data for utility scale operations (although the data used are from the 1980's). Included here is a link to the NREL website: http://www.nrel.gov/gis/wind.html.
- *Alternating current*s are necessary to gauge actual, site-specific wind levels.
- Common wind turbine height limits in Maryland range from 90 to 250 feet depending upon the region. Some jurisdictions have calculated a "safety setback" based on the turbine height times 1.5
- There should be an unobstructed path for wind generation of about 500 feet from and 30 feet above trees or other obstructions.
- Residential models are available which mount on homes in which cases the returns are small but immediate.
- While vertical axis blades supposedly capture more turbulent wind, they tend to be less stable and less efficient.
- State grant program, funded with stimulus dollars, is available for larger, small-scale turbines. Ninety percent of the funding goes toward efficiency; 9% goes to solar energy; 1% goes to wind energy projects.
- Following installation of a turbine, a homeowner can expect return on investment in 5 to 17 years.

Wind Turbine Information
Wind turbines are mechanical devices that extract energy from passing wind and convert it into electrical energy. These turbines can be either horizontal or vertical axis. The horizontal axis turbines control the mass market at this time, in both the small residential class as well as the large commercial power class. Horizontal axis turbines are mounted on towers in order to place the blades above ground level and to increase the available wind resource.

Wind turbines are rated by the number of watts they can produce while rotating at maximum rpm's. A 4-*kilowatt* rating means that the turbine can produce 4000 watts of electrical capacity, and if timed for one hour at this output, will produce 4 *kilowatt hours* of power. This is enough power to keep forty 100-watt light bulbs glowing for one hour. Residential size turbines are generally in the 1-10 *kilowatt* power range, while commercial turbines are generally in the 1-5 *megawatt* range. A *megawatt* is 1000 *kilowatts*.

Appendix B: Background Information for Wind Energy *continued*

Wind turbines require a device called an *inverter* to change the output energy to 120/240 volt *alternating current* if one wishes to power a conventional house or sell the power to the power grid (the grid is the current paradigm of power production, distribution, and consumption, including power plants, transmission lines, and consumers). If one wishes to live "off the grid", i.e. without being hooked up to Delmarva or Choptank, then the energy can be used directly in conjunction with a storage device, usually a large bank of batteries: the wind turbine charges the batteries, the batteries power the house either directly or through an *inverter*.

To work well, wind turbines need steady and smooth flowing wind. Wind that is light, full of cross currents, or is disturbed by near-by trees, buildings, ground-effect friction, or other obstructions will prove of little value to a turbine, and will produce only a fraction of the turbine's rated power. A turbine that is 45 feet above ground, even in a relatively clear field will suffer from smaller wind flow than a turbine in the same location that is elevated 100' to 150' above ground level. This is due to the fact that ground-induced friction slows down the wind, and the taller towers raise the turbine above the worst effects of this physical limitation. Trees, structures, gorges, bluffs, and other physical irregularities many hundreds of feet away can cause the wind passing the turbine to increase or decrease, depending on wind direction relative to the turbine. Just as in real estate, a turbine's value is enhanced by its location and its elevation. Most turbines need a minimum average wind speed of 12-15 mph to produce their rated capacity. Power production at low wind speeds is minimal, and there may be a minimum threshold wind speed necessary to produce enough turbine rpm's to initiate energy production. An increase in wind speed causes an exponential (not arithmetic) increase in power: power production at 20 mph is not twice that of wind at 10 mph, but eight times greater.

Wind turbines at the residential scale require comparatively small amounts of regular maintenance. The size of the supporting tower is directly related to the cost of maintenance. Maintenance on a 1 *kilowatt* turbine on a 35' tower can be done by (usually) climbing the tower. On the other hand, a 10 *kilowatt* turbine on a 75' tower requires a crane to handle most of the maintenance, and crane availability and site access may become challenging and the costs involved substantial. Above 10 *kilowatts*, turbine and tower maintenance is almost always done by professionals, at regular intervals and at substantial annual cost.

Wind turbine safety concerns are also related to size, meaning the larger the tower and turbine, the greater the safety hazard and need for regulation. If a 1 *kilowatt* turbine on a short tower throws a blade, it will not go far, nor will it do too much damage or personal injury. If the tower falls, it will not likely crash on the neighbors house. If a 10 *kilowatt* turbine/tower experiences these problems, the outcome is guaranteed to be less benign. If a 100 *kilowatt* turbine/tower does so, things in proximity are in danger. As a general rule, scale increases safety concerns, just as wind force increases power output. In addition, towers above 150' may require Federal Aviation Authority approval and/or lighting.

Wind turbines are also of concern for potential environmental impacts, with birds and bats the species of primary interest. There have been numerous studies regarding the impacts of the spinning blades and the structures of the towers on these species. In general larger turbines on higher towers present a greater threat, and the structure of the towers itself can present a problem (guyed versus un-guyed, open lattice versus closed). Lighted towers seem to present a greater risk. Location of the turbine/tower is important, and initial site selection to avoid migratory pathways is crucial. Most of the studies performed have involved commercial scale turbines on wind farms. The avian impact study done at Eastern Neck is one of the few in the country to examine small scale turbines: it was found that on average there are at least three bird strikes per year with the 10 kW turbine mounted on a 60 foot tower.

Legal concerns for wind turbine placement are based on these aforementioned safety factors and other considerations. Set back requirements must consider tower height, blade throw distances, noise production,

wind buffering of nearby turbines, visual factors, neighborhood makeup, and grid tie-in requirements. An environmental impact study looking at avian and bat impacts should be required. While wind resource is critical for any possibility of economic success, lack of wind resource can not be a legal reason to deny siting permission.

There are two common physical configurations of wind turbines: horizontal axis and vertical axis. Horizontal axis wind turbines, also known as HAWT, have blades, or rotors, which must be pointed into the wind to capture the resource (Figure 4).

Figure 4: Horizontal Axis

Figure 5: Vertical Axis

Vertical axis small wind energy systems (VAWT) have their blades arranged vertically and do not require being pointed into the wind (Figure 5). Both types of turbines can be mounted on top of wind towers or on buildings (Figure 4) and can reach speeds up to six times the wind speed. A wind tower can be constructed as a monopole, as in Figure 2, or as a lattice or guyed structure.

Figure 6: Building-mounted

To operate efficiently, the wind turbine must be placed at a height to avoid the friction, or ground drag, created when the air moves across the earth's surface. It also must be placed high enough to avoid the turbulence caused by ground clutter, which includes trees and buildings. The rule of thumb is to site the turbine so that the bottom of the blade clears the highest wind obstacle that is within a 500 foot radius by at least 30 feet. To reduce the effects of ground clutter, the best location for a wind turbine is often the highest point on a property.

An added benefit to placing a turbine at increased heights is that wind speeds can increase dramatically with distance from the ground. Generally, the higher the tower, the greater the potential energy to be captured. Because of the costs involved, however, tower height is usually limited to suit the financial needs of the user. Typically, freestanding wind turbines used in small energy systems range in height from 35 to 150 feet.

The smaller scale systems, in the range of 1 to 10 kW, are generally capable of producing enough energy to support a household, farm or small business. Even smaller turbines can be used for specific purposes, such as pumping water for irrigation or to run appliances. Larger turbines are appropriate for commercial or institutional uses with larger energy needs.

Appendix B: Background Information for Wind Energy *continued*

While small wind energy systems can be mounted on buildings to capture wind energy above the rooftops, this is not recommended. Over time, the wind turbine can damage the structure of the building because of the vibration it produces. Additionally, there is evidence that building-mounted systems are not efficient in producing energy. Recent studies show that the performance of building-mounted models is generally poor due to wind turbulence. However, in some places, such as along shorelines, good wind may be available at rooftop height.

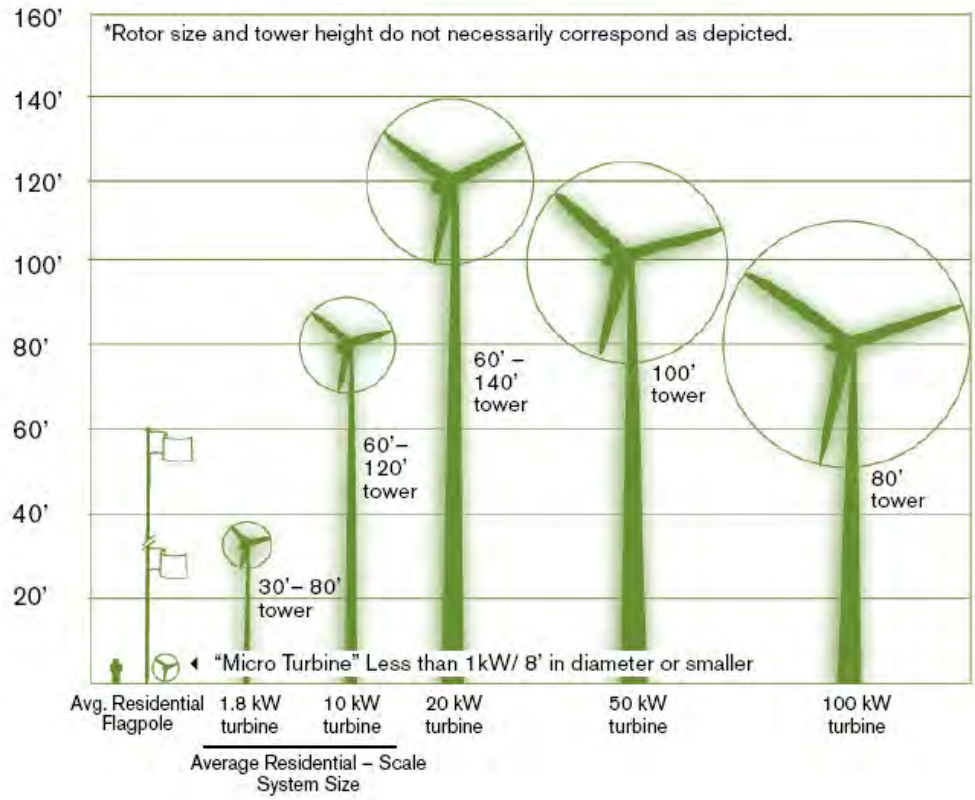


Figure 7: Typical Range of Small Wind Energy Systems

The cost of a small wind energy system can range roughly between $3,500 and $40,000, depending on the size and type, or approximately $3,000 to $5,000 per *kilowatt* of generating capacity. Thus, a 2kW system, which, under ideal conditions, has the potential to generate enough energy for an average household, would cost around $8,000. If optimally located, the system will typically pay for itself in 15 years while the life of a wind turbine is typically 20-30 years.

Technology is quickly evolving in this field. More and newer kinds of wind turbines are being created which are better able to capture the potential power with less wind resources. The energy ball (Figure 6) sold by Dutch Based Home Energy International, for example, spins at lower wind speeds and creates less noise, while still capturing ample potential power.

Figure 8: Energy Ball

Appendix B: Background Information for Solar Energy

Guest Speaker

Robert Busler discussed his experiences as a representative of the solar energy company Standard Solar. He shared examples of roof mounted solar panels on a wide variety of residences and shared his own experience with the roof mounted solar panels installed on his residence in Chestertown's historic district.

In addition to leading a discussion on the aesthetics of solar panel installation, Mr. Busler shared the following topics for the task force's consideration:

- Roof Mounting (left)
  - Alignment with existing roof slope
  - Color of panels
  - Appearance of cell pattern
  - Mounting systems

Figure 9: Roof mounting

Figure 10: Ground Mounting

- Ground Mounting (right)
  - Height of system
  - Views from neighboring property
  - Glare at 30 degree tilt - none

Background

The most common solar technologies used on buildings in the United States are solar photovoltaic (PV) panels that generate electricity and solar thermal systems that heat water or air. Solar PV produces electricity through the conversion of direct sunlight to energy. The semiconductor materials in the PV cell interact with the sunlight to generate electric current. The most electricity is produced when the sun's rays are directly perpendicular to the PV panels. Since PV only works with sunlight, most systems are also connected to the utility grid to guarantee around-the-clock electricity. The orientation of a PV system affects its performance; usually the best location is on a south-facing roof. Flat roofs allow the panels to be tilted in the optimal direction.

PV systems work best without any obstructions from trees or structures. Because the sun is higher in the summer and lower in winter, placement of the PV involves an assessment of these factors. In any specific location, as the surface area of a PV system exposed to sunlight increases, the amount of electricity produced also increases. Depending on site conditions and economic constraints, residential-scale PV systems can range

from 100 to 1,000 square feet. ("Balancing the Solar Access Equation", Gail Feldman and Dan Marks, aicp, Zoning Practice 4.09).

Two Sources of Energy: Light and Heat

- Light
  - Photovoltaics (PV) - direct conversion of sunlight to electricity.
- Heat
  - Active solar thermal heats water.
  - Passive solar thermal heats a building through design (windows, orientation, etc.)

Components of Solar PV Systems

- Solar panels – mounted on roof, pole, ground, or other structure
- *Inverter* – DC to AC
- Balance of System (BOS)
  - Charge Controller (battery systems)
  - Disconnect switch (usually *inverter*-integrated)
  - Circuit breaker box
- Backup System – add batteries, different *inverter*, second breaker box, move circuits

Solar Energy Information

Solar energy can be captured and converted into heat or electricity by a number of devices. For example, a result of the fuel shortages in the 1970's, many homes and buildings in the U.S. were fitted with flat collectors that captured solar energy because of the dark color of the collector. This energy was then used to heat water (most often by running a thin film of water directly through the hot panel) to replace conventionally produced hot water. In some cases the energy was used to heat or help heat the home.

There are many methods of collecting solar energy and converting it to electrical power, but in general most systems can be classified as belonging to either of two main groups. The first group is made up of photovoltaics (PV), as discussed above. There is also Concentrating Solar PV (CPV) which uses a lens to increase the available sunlight onto a much smaller but more efficient PV cell, but the system must be mounted on a two axis tracker to constantly and accurately point the lens at the sun. The second main group is comprised of concentrating solar power (CSP) in which parabolic troughs are used to concentrate sunlight onto a central pipe filled with oil which absorbs the energy as heat. This oil is then circulated to a heat exchanger which then is used to ultimately generate steam to drive a turbine and generator (much like fossil fuel electrical production). Most small-scale solar power systems employ photovoltaics.

The most common form of PV is the rigid silicon crystal solar cell. One of these PV cells is manufactured by arranging many thinly cut layers of silicon crystal in large flat rigid, glass covered sheets called cells, which in turn are arranged in collections called arrays. These arrays are often seen on roofs of residences, businesses, and public buildings; covering large areas of usually southern exposures, supported by racks that hold them at varied angles aimed at the sun.

Sometimes these same arrays are ground mounted on racks or poles. They can be rigidly mounted, or on poles that let the arrays move to follow the sun from East to West, or from the horizon to the high noon for

cost considerations, they are rigidly mounted at an average angle, usually an angle in degrees equal to or near position, or both simultaneously. Efficiency is improved when the panels can track the sun. Most commonly, the geographical latitude of the array (39 to 40 degrees for Kent County). Usually they are mounted facing south as near as possible, given other considerations such as roofline layout or landscaping.

These cells turn sunlight into electricity due to the unique ability of the specially treated silicon to shed an electron that will then follow a circuit the manufacturer laid out in the construction of the cell. Electrons excited by the sunlight falling on the surface of the cell can move about, creating an electrical current which travels from the cell to a load (such as the electrical devices in a home) and back to the cell.

Generally, the trip goes first to an *inverter*, which changes the DC current from the cell to AC current (which can be used in the home or business), then on to a distribution panel, such as the one that houses the circuit breakers for your house.

If you are connected to the electrical grid, the power you do not use for your household loads at the very instant the current is created will flow backwards through your electrical meter to the rest of the grid, turning your meter backwards if you have one meter, or registering on your "watts produced" meter if you have two.

If you are not connected to the grid, the current may go directly from the PV array to a bank of batteries for storage, from which it is later taken and either used directly to power DC lights and appliances or converted into AC. A system of this type that is also connected to the grid must have either an automatic or manual disconnect switch that allows connection to only one source (grid or solar array) at a time.

Other types of less common solar collectors include thin cell PV and concentrating solar PV collectors. Thin cell solar is just that: a very thin and flexible cell structure printed on a plastic scrim with an adhesive backing that can be applied as a building material on roofs or external walls of buildings. It is a less efficient collector of solar energy than silicon crystal, but many times cheaper, and its flexibility allows it to be incorporated into the structure rather than being an add-on.

Concentrating solar is a PV cell that has its own concentrating device looking like a reverse Fresnel lens (like those used to concentrate the beams in lighthouses) which concentrates the solar energy many times, allowing for a smaller but more efficient solar cell. This cell must have a two-axis pointing device so that the cell is always pointed directly at the sun.

Researchers are also searching for materials other than silicon that can be used in PV. Suitable materials will decrease the cost of solar panels by either increasing efficiency (more sunlight captured) or decreasing the cost of manufacture, or both.

The unit of measure of how much electrical power a solar array produces is the *kilowatt hour* (kWh) which is the number of *kilowatts* (kW) produced in one hour of time. The size of an array is rated by how many kWh's it can be expected to produce, in perfect solar conditions, in one hour. An array that can be expected to produce 5 kW's in one hour is rated as a 5kW system. Larger commercial systems are measured in *Megawatts* (mW), with a *megawatt* being equal to 1000 *kilowatts*.

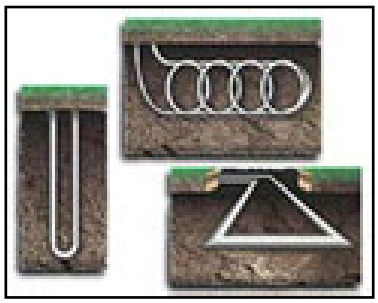
Appendix B: Background Information for Geothermal Energy

Guest Speakers

Mr. Pinder and Mr. Piposzar, of Pinder Service Company, discussed their installation experience with geothermal wells. They provided the committee with a document entitled "Geothermal Overview" which outlines how a geothermal system works, the types of systems available, and information regarding chemicals used specifically in vertical closed loop systems.

Background

The most common type of geothermal installation is a closed loop system. The heat exchanger - a loop of piping filled with fluid - is buried underground. The fluid circulates continuously inside the buried pipe, absorbing heat from the earth during the winter for use inside your home or business. In warmer months, the fluid takes heat from indoors and transfers it back into the earth.



A central closed loop system has all heat pumps in a central room; air or water is ducted and circulated to the heated or cooled rooms. Commercial applications include chiller or rooftop unit retrofits. Distributed systems use a central water pump and heat pumps serving individual rooms and areas. Types of buildings served included offices and schools, both new construction and retrofits.

Figure 11: Types of closed loop systems

Since multiple units are heating and cooling simultaneously, the distributed system can provide heat recovery from core zones that have excess heat to perimeter zones that require heat. A distributed system also permits location of relatively small individual units in restricted areas, such as historic districts.

Modular systems have dedicated heat pumps, water pumps and loops. This type of system allows for independent individual control, operation and maintenance. Types of buildings suitable for a modular approach include schools, with modules serving individual classrooms, and other buildings where usage and environment are clearly separated.

A hybrid system uses a cooling tower or other means to reject excess heat not needed for winter heating. The cooling tower reduces the size of the ground heat exchanger and the cost of installation.

Horizontal loops

If adequate land area without hard rock is available, a horizontal loop installation is usually the most economical. Horizontal loops are often used for newly constructed homes and commercial buildings. A horizontal system uses a number of trenches. The piping can be configured in the trenches in several ways:

- A single pipe;
- Multiple pipes in a narrow trench; or
- Multiple pipes in a wider trench.

The trenches are normally four feet deep or more, and vary in length depending on the number of pipes to be buried. One of the advantages of a horizontal loop system is having the flexibility of laying the pipes in different-sized lots.

Figure 12: Horizontal Loop System

Vertical loops

Figure 13: Vertical Loop System

If the land area available is limited, a vertical loop may be installed for the geothermal piping. Vertical installations might also be used where the land is too rocky for trenching, for existing buildings, and for large commercial or educational facilities. To install a vertical loop, a contractor will bore holes into the ground. Long, hairpin-shaped loops of pipe are then inserted. The hole is backfilled, plugged or grouted, and the pipes are connected to headers in a trench leading back to the building.

The drilling depth is determined by the lowest total cost based on the conditions at the job site. A typical borehole depth is 150 to 250 feet. The objective of a vertical borehole is to install a specific amount of pipe, not to reach a certain depth. If 1,200 feet of pipe is required, three 200-foot boreholes are acceptable and may be the most cost-effective arrangement. Drilling boreholes for geothermal loops is much simpler than drilling to find well water. The borehole is generally smaller, which reduces drilling time, and no casing is required because the hairpin-shaped loop is the actual casing for the pipes.

Slinky coils

An increasingly popular approach, especially in residential systems, is a "slinky" coil. A slinky is a coil of plastic tubing spread out and overlapped in a trench and buried. Slinky coils are installed horizontally at the bottom of a three-foot-wide trench. This method concentrates the heat transfer surface into a small volume, requiring less land area and shorter trenching - a big plus for homeowners. A compact slinky coil will reduce trench length by about two-thirds; an extended slinky will reduce trench length by about one-third. Specific design lengths will vary with the climate, soil and the heat pump's capacity.

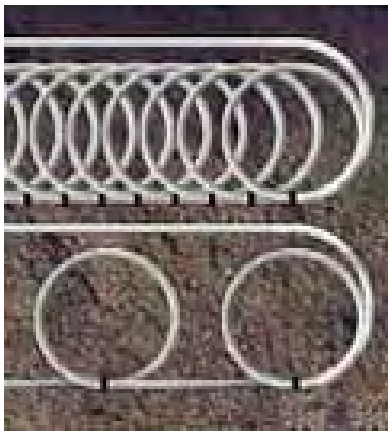


Figure 14: Slinky Loop System

Open Loop Systems

While the majority of geothermal installations use a closed loop system, another option is an open loop system. While a closed loop system uses an antifreeze solution sealed inside the buried piping, an open loop system uses water from a surface or underground source - such as a pond, lake or well.

The water is pumped into the heat pump unit where the heat is extracted; the water is then discharged back into the original source. Well water designs are the most common and most cost-effective. The well supplies both household water and water for the heat pump. Approximately three gallons per minute of well water are needed per ton of cooling capacity. A 3,000-square-foot, well-insulated home would typically require 10 to 15 gallons per minute.

Water quality is an important issue with open-loop systems. Mineral deposits can build up inside the heat exchanger, iron and other impurities can clog a return well, and organic matter from ponds and lakes can quickly damage a geothermal system. Water should be tested for acidity, mineral content and corrosiveness.

Appendix B: Background Information for Biomass Energy

Background

Biomass is defined as any organic matter (anything that was once alive) that can be used as an energy source. Wood, crops, and yard and animal waste are examples of biomass. People have used biomass longer than any other energy source. Biomass gets its energy from the sun. Green plants absorb solar energy in a process called photosynthesis, in which sunlight, carbon dioxide, water, and nutrients from the soil are combined to make sugars called carbohydrates along with oxygen. The carbohydrates can latter be broken down through various processes to produce a fuel from which this energy can be regained. Carbon dioxide will be a byproduct. Fossil fuels are biomass that was made a very long time ago.

There are also plants (such as soybeans) that produce oil enriched seeds, and in addition the cells of certain forms of algae contain oil-enriched compounds called lipids. In one process, the algae are grown using municipal wastewater as a food source. The oils from the plant seeds and algal lipids can be extracted and used directly as a source of fuel that is known as "bio-diesel." It has also become popular to use waste cooking oil as a source of bio-diesel.

Biomass is called a renewable energy source because more of it can be grown in a short period of time.

Biomass can pollute the air when it is burned, though depending on the form (solid, liquid or gas) and type of fuel, not as much as some types of fossil fuel. Burning biomass fuel does not produce pollutants like sulfur, which can cause acid rain. Growing plants for biomass fuel may reduce greenhouse gases, since plants use carbon dioxide and produce oxygen as they grow. Carbon dioxide is considered an important greenhouse gas.

Biomass Uses

Until the mid-1800s, wood provided Americans 90 percent of the materials used to create energy. Today, biomass provides a little over 3 percent of those materials, having been replaced by coal, natural gas, petroleum, and other energy sources. Most biomass energy comes from wood. It accounts for two-thirds of biomass consumption. Other biomass sources include biofuels (alcohol fuels), crops, garbage, and landfill gas.

Industry is the biggest biomass consumer today; it uses 52 percent of biomass to make products. Homes and businesses are the second biggest users: about 1 in 5 homes burn wood in fireplaces and stoves for additional heat and 1 percent uses wood as its main heating fuel. The transportation sector uses 21 percent of biomass to make ethanol and other biofuels. Power companies use biomass to produce electricity. Almost 11 percent of biomass is used to generate electricity today.

In the future, trees and other plants may be grown to fuel power plants. The agricultural community may also produce crops which can be converted into ethanol and other biofuels.

There are four ways to release the energy stored in biomass: burning, bacterial decay, fermentation, and conversion to gas/liquid fuel:

Burning

Wood was the biggest energy provider in the United States and the rest of the world until the mid-1800s. Wood heated homes and fueled factories. Today, wood provides only a very little of the nation's overall energy needs. Wood is not the only biomass that can be burned. For example, wood shavings, fruit pits, manure, pellets, and corn cobs can all be burned for energy.

Garbage is another source of biomass energy. Garbage can be burned to generate steam and electricity. Power plants that burn garbage and other waste for energy are called waste-to-energy plants. These plants are a lot like coal-fired plants. The difference is the fuel. Garbage does not

contain as much heat energy as coal. It takes about 2,000 pounds of garbage to equal the heat energy in 500 pounds of coal.

Sometimes, fast-growing crops like sugar cane are grown especially for their energy value. Research is currently being conducted to investigate ways to grow aquatic plants like seaweed to use for their energy value.

Bacterial Decay

Bacteria feed on dead plants and animals. As the plants and animals decay, they produce a colorless, odorless gas called methane. Methane gas is rich in energy. Methane is the main ingredient in natural gas, which is used in furnaces and stoves. In some landfills, wells are drilled into the piles of refuse to capture methane produced from the decaying waste. The methane can be purified and used as an energy source comparable to natural gas.

Fermentation

Some forms of biomass can be broken down by yeast to produce an alcohol called ethanol (the yeast consume the sugars of the biomass in a process called fermentation). Corn, wheat and many other grain crops having simple sugars, and crops like sugar beets and sugar cane, can be used directly: this is how ethanol is currently produced in the United States and in foreign countries like Brazil. Other forms of biomass that are cellulose or complex sugar based (such as crop stover, wood chips or residue, or plants like switch grass) must first be chemically broken down into more simple sugars before the fermentation can take place. This process is just starting to achieve production on a commercial scale.

Ethanol can be used as a motor fuel. Ethanol is more expensive to use than gasoline and provides less energy per gallon. Currently ethanol is mixed with gasoline to produce a fuel called E-10, which is 90% gasoline and 10% ethanol. New model cars are rated for E-15, which has 15% ethanol. For cars to run on pure ethanol, their engines must be altered; however, most late model cars can run on E-10 without alteration. Adding ethanol to gasoline reduces ozone pollution, but slightly decreases vehicle mileage due to the reduced energy content of alcohol as compared to gasoline.

Conversion

Conversion means changing a material into something else. Biomass can be used as is or converted into gas and liquid fuels. This is accomplished by adding heat or chemicals to the biomass. The gas or liquid fuels can then be burned to produce heat or electricity, or it can be used as a fuel for automobiles. Manure may also be converted to methane gas to provide heat or light.

Appendix C: Resources

Biomass energy resources:

- http://www.need.org/needpdf/infobook_activities/IntInfo/BiomassI.pdf
- http://www.ucsusa.org/clean_energy/technology_and_impacts/energy_technologies/how-biomass-energy-works.html
- http://www.nrel.gov/learning/re_biomass.html
- http://www.nrel.gov/biomass/
- http://www1.eere.energy.gov/biomass/
- http://www.infinitepower.org/newfact/new96-819-No15.pdf
- http://www.epa.gov/methane/
- http://www.epa.gov/agstar/profiles/bluespruce.html.
- http://www.epa.gov/agstar/operational.html#md.
- http://www.mde.maryland.gov/researchcenter/publications/general/emde/vol4no3/woodburning.asp

General renewable energy resources:

- Willis, Terry. "Alternative Energy Systems," 24 March 2010.
- http://www.nytimes.com/2010/08/10/science/earth/10portugal.html?_r=1&ref=world

Geothermal energy resources:

- http://www.energysavers.gov/your_home/space_heating_cooling/index.cfm/mytopic=12650
- http://www.alliantenergygeothermal.com/HowItWorks/ClosedLoopSystems/index.htm
- http://www.alliantenergygeothermal.com/HowItWorks/OpenLoopSystems/index.htm
- http://www.michigan.gov/documents/deq/dnre-wb-dwehs-wcu-bestpracticesgeothermal_311868_7.pdf
- http://www1.eere.energy.gov/geothermal/powerplants.html
- http://en.wikipedia.org/wiki/Wairakei_Power_Station
- Pinder Service Company, *Geothermal Overview*

Solar energy resources:

- City of Boulder, Colorado*, Solar Access Guide*.
- Feldman, Gail and Dan Marks. "Balancing the Solar Equation." *American Planning Association Zoning Practice, 4.09*.
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- Zucker, Scott I. *American Solar Energy Society*. 9 February 2010.

Wind energy resources:

- American Wind Energy Association. "How and Why to Permit for Small Wind Systems: A Guide for State and Local Governments." *In the Public Interest*, September 2008.
- Baltimore, Howard, and Talbot Counties and the Town of Ocean City Wind Energy
- Maryland Model Wind Energy Ordinance
- Sagrillo, Mick and Ian Woofenden. "How to Buy a Wind Generator." *home power 131,* June and July 2009.
- US Department of Energy. "Small Wind Electric Systems: A Maryland Consumer's Guide." August 2009.
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