SUSTAINABLE LAND USE CODE PROJECT
Capitol Region Council of Governments





MODEL REGULATIONS: ALTERNATIVE ENERGY
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Introduction

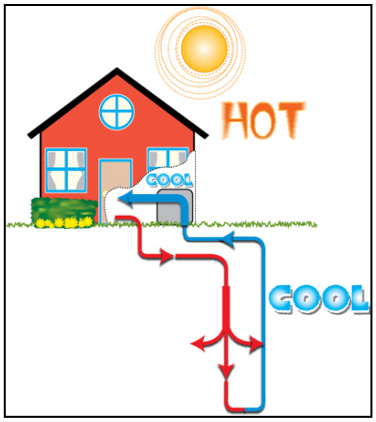
Residential solar panels

Alternative energy sources such as wind, sun, geothermal, and biofuels are becoming more viable sources for power as technology advances. In the U.S. only about 12 percent of energy is generated from renewable sources, and only about 0.2 percent from solar.[1] Some experts believe these percentages will increase rapidly as solar energy system costs decrease and the price of fossil fuels rises--to the extent that solar energy may be on par with the cost of energy from fossil fuels by 2015 and cheaper by 2025. Awareness and interest in these issues have also increased as funding and incentives for energy conservation, and alternative energy projects have become more readily available to local governments, businesses, and homeowners.

Below some of the alternative energy sources with the greatest potential in the Capitol Region are summarized.[2]

The CNC Software facility in Tolland uses free-standing solar panel arrays to generate electricity. The facility also uses geothermal systems for heating.

- Solar hot water systems are appealing because they are technically simple and tend to be less expensive than other types of renewable energy systems for most applications. The most cost-effective application of solar hot water systems in Connecticut is for domestic hot water heating, particularly if it displaces electric water heating. While the capital cost of installing a residential solar hot water system is higher than that of installing a conventional water heater, the fuel savings can pay back the cost of the system in approximately 6 to 10 years, with federal and state incentives. A typical residential solar hot water system supplies about 70 percent of a home's hot water, saving 7.7 barrels of oil per year, and avoiding the production of almost 3.5 tons of carbon dioxide. The average commercial solar hot water system supplies about 109 MMBtu (210,000 gallons) of useful hot water, saving about 800 gallons of fuel oil per year and eliminating the production of almost 10 tons of carbon dioxide. Solar electric systems for residential energy supply also have potential in Connecticut in specific locations.



Ground source heat pump

- Geothermal systems such as ground source heat pumps draw upon the relatively constant temperature (~50-55° F) of the soil or ground water deep beneath the earth's surface to efficiently heat buildings during colder months and cool buildings during warmer months. Because the heat pump transfers heat from one location to another (like an air conditioner), most of the heat delivered is "free" and does not have to be supplied by fossil fuels or electric energy. Energy savings for a typical home geothermal heating/cooling system typically range from 30 percent to 70 percent, with the geothermal system being most attractive

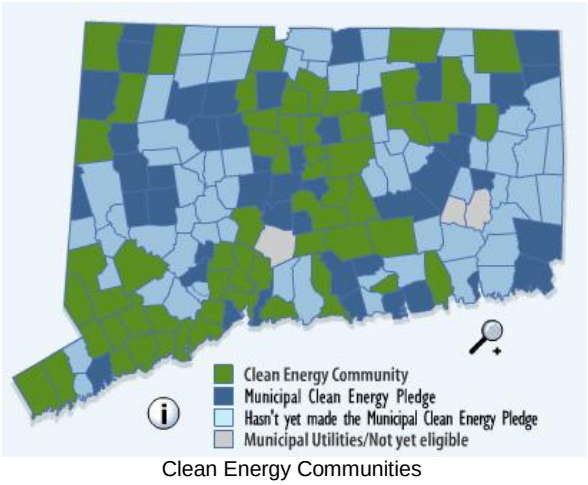
[1] U.S. Energy Information Administration / *Monthly Energy Review June 2012*.
[2] Information from Clean Energy Finance and Investment Authority. http://www.ctcleanenergy.com

compared to electric resistance heating.


Small wind system

- Wind turbines or windmills convert kinetic energy from the wind into mechanical power that can then be converted into electricity. New technology has improved their efficiency and thus reduced their cost and size. Although there are few sites in the region suitable for large-scale wind energy systems, there are more location-specific opportunities for use of small wind systems.
- District heating with combined heat and power (CHP) (also known as cogeneration) involve electric generation systems that recover waste heat byproduct and deliver both the electrical and thermal energy to the host site. The Connecticut Academy of Science and Engineering (CASE) examined the potential for district heating and cooling and combined heat and power (CHP), as well as waste heat applications. The initial findings from its study indicate that large commercial CHP and district heating and cooling systems in Connecticut have the potential to reduce carbon dioxide by up to 8.1 million metric tons.

Connecticut has been one of the leaders in addressing energy conservation (including recycling) and the use of alternative energy sources. The state adopted Renewable Portfolio Standards (RPS) that call for renewable energy sources to produce 16 percent of the electric generation provided to Connecticut consumers by 2012, increasing to 19.5 percent by 2015 and 27 percent by 2020. The Connecticut Global Warming Solutions Act of 2008 (GWSA) requires the state to reduce greenhouse gases to 10 percent below 1990 levels by 2020 and to 80 percent below 2001 levels by 2050. A number of state programs address energy conservation and alternative energy systems. The Clean Energy Finance and Investment Authority (CEFIA), offers a number of financial assistance programs for alternative energy systems, including: the Connecticut Clean Energy Communities program (which allows municipalities agreeing to assess energy use in municipal facilities to earn free clean energy systems to meet energy reduction targets those facilities); Solarize Connecticut (a pilot program using education, marketing, and pricing incentives to encourage use of residential solar photovoltaic systems); grants to residents for the purchase of solar hot water and photovoltaic systems; a program to create incentives for the use of ground source heat pumps for residential and commercial space and water heating; and help in financing equipment for energy generating projects using on-site anaerobic digestion (OAD) and combined heat & power (CHP).[3]



Clean Energy Communities

In addition, the Connecticut Energy Efficiency Fund (CEEF), adminisitered by major utility companies in the state, supports a number of energy efficiency programs. It has a rebate program for small photovoltaic solar systems and is creating a similar rebate program for small wind energy systems.[4]

Municipalities within the Capitol Region have incorporated a number of provisions into their land use regulations that address alternative energy systems. Several expressly allow small wind energy systems

[3] See Clean Energy Finance and Investment Authority. http://www.ctcleanenergy.com.
[4] See Connecticut Energy Efficiency Fund. http://ctsavesenergy.org/.

in multiple zoning districts (e.g., Avon, Ellington, Farmington, Simsbury, Windsor). Enfield recently adopted detailed, modern standards for the installation of solar energy systems. A few include solar access among those aspects required to be considered when laying out subdivision streets and lots (e.g., Ellington, Manchester). Windsor goes a step further in providing the incentive of increased lot coverage limits for developments in industrial zones that use geothermal or solar energy. Hartford has provisions in its zoning regulations addressing district heating and cooling facilities.

KEY TOPICS:

- Solar collection systems
- Small wind energy systems
- Ground source heat pumps
- District heating and cooling

SCALE-UP OPTIONS MENU

- Solar access provions
- Solar-ready homes
- Alternative energy incentives

However, many jurisdictions in the region do not address alternative energy systems in their land use regulations, although some do process applications using existing general accessory use standards. Others reportedly review applications informally on an ad hoc basis. Several recent national studies have established that the lack of clear local zoning standards for alternative energy systems creates uncertainty for installers and constitutes a major stumbling block to increased use of such systems. Moreover, variable and sometimes contradictory regulations among local governments in a region also has been documented as another significant hindrance.

Based on the potential of specific alternative energy sources and the priorities indicated by the project municipalities, we have drafted land use regulations to accommodate and promote the installation of solar, wind, geothermal, and district energy systems. In several sections, we have set forth what are called “scale-up options” that represent additional regulatory or incentive provisions a local government might want to consider.

Model Code Provisions for Alternative Energy

1.1. ALTERNATIVE ENERGY SYSTEMS--GENERAL

1.1.1. PURPOSES

The purposes of these provisions relating to alternative energy systems are to:

A. Promote the use of wind, solar, ground source heat pumps and other alternative energy systems;

B. Provide opportunities for homeowners to save fuel costs;

C. Encourage single-family residential subdivision design that allows the orientation of structures to maximize solar access;

D. Encourage orientation of single-family dwellings on solar-oriented lots to take maximum advantage of solar access;

E. Promote street design that supports solar access;

F. Ensure that site elements do not excessively shade potential solar system locations;

G. Preserve access to wind for small wind energy systems;

H. Establish standards to encourage the use of ground source heat pumps; and

I. Ensure that alternative energy system are safe and compatible with surrounding developments.

1.1.2. DEFINITIONS

Note: Relevant definitions are set forth in each subsection that follows. These definitions should be included in the definition section of the local land use regulations.

1.2. SOLAR COLLECTION SYSTEM

Solar collection systems are solar panels mounted on roofs and walls as accessory uses. Solar arrays are collection of smaller solar units that work together as a single system. This section and the next provide standards for solar collectors as an accessory use and solar arrays as both a by-right permited accessory use and as a limited primary use. Some local ordinances collectively address both freestanding solar devices (solar arrays) as well as building-mounted solar panels, applying the same standards. Since freestanding ground-mounted solar arrays are becoming more common, we have included them as a separate use type for discussion. We have organized collectors and arrays under separate headings and drafted the definitions to reflect a clear distinction between the two types of facilities and their potentially different impacts.

1.2.1. DEFINITION: SOLAR COLLECTION SYSTEM, SMALL

A "solar collection system, small" shall mean a roof-mounted, wall-mounted panel, or other solar energy device other than a solar array with a rated capacity of up to 10 kilowatts.[5] The primary purpose of a small solar collection system is to provide for the collection, inversion, storage, and distribution of solar energy for electricity generation, space heating, space cooling, or water heating on-site; however, any excess energy output may be delivered to a power grid to offset the cost of energy on-site.

Solar collection system

1.2.2. STANDARDS

All small solar collection systems shall comply with the following requirements. If there is any conflict between the provisions of this section and any other requirements of the zoning or subdivision regulations, the provisions of this section shall take precedence.

A. Accessory Use

Small solar collection systems shall be allowed as a permitted accessory use in every zone district. However, small solar collection systems are not subject to the dimensional requirements of the accessory land use and development provisions in any zone district or other section of these regulations, to the extent they conflict with this section.

B. Setbacks, Location, and Height

1. A solar collection system shall be located a minimum of five feet from all property lines and other structures, except the structure on which it is mounted.
2. A solar collection system shall not exceed by more than three feet the maximum height permitted in the zoning district in which it is located or shall not extend more than 12 inches above the roofline or parapet of the structure upon which it is mounted, whichever is less.[6]
3. A solar collection system may be located on an accessory structure.
4. A development proposed to have a solar collection system located on the roof or attached to a structure, or an application to establish a system on an existing structure, shall provide a structural certification as part of the building permit application.

[5] The average size of a grid-connected residential solar system is currently six kilowatts and has been on an upward trend for a decade. We have established the standard in these model regulations at 10 kilowatts to reflect what is commonly recognized as the dividing line between small residential systems and larger systems, as well as to account for estimated increases in size over the next few years. Each local government will need to adjust this measurement in the future as residential systems become more efficient.

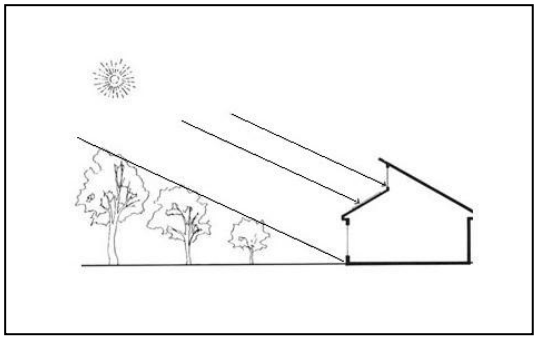
[6] Some communities require flush-mounted panels, but this can compromise function depending on the roof orientation and angle.

C. Code Compliance

Solar collection systems shall comply with all applicable state building and electrical codes.

D. Solar Access Preservation

No vegetation or site features such as tall fences shall be planted, installed, or constructed on any lot in a new subdivision subject to this section that would block solar access to the south wall of a dwelling unit in the subdivision or would block sunlight 50 percent or more of the time on any day of the year from the south facing roof of the dwelling. This provision shall not apply to the planting of vegetation or trees on any existing lot and shall not be interpreted to require the cutting down of existing trees or removal of existing vegetation.[7]



Sun access to south facing roof

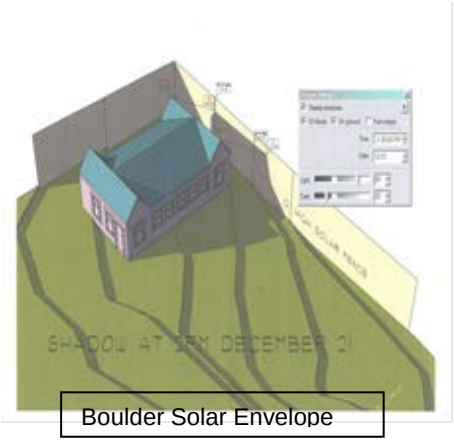
E. Off-Street Parking and Loading Requirements

None.

[7] This provision can be enforced like many local landscaping provisions and can be enforced through typical zoning enforcement measures, most likely as identified on a complaint basis. See also Footnote 8 herein.

Scale-Up Option—Solar Access Protection

The solar access provision set forth in Section 1.2.2.C is minimal and applies only to lots in new subdivisions, not to existing lots. Protecting solar access is important to ensuring the viability of solar power. Communities that are serious about promoting solar energy approach this in a variety of ways, including: 1) requiring solar users to negotiate necessary solar access with neighboring property owners; 2) establishing basic standards that prevent the construction of structures or planting of vegetation on adjacent property that would block the sun; and 3) establish a formal system to protect "solar access" and "solar access rights," administered by the local government, and requires applicants to apply for a solar access permit. For example, Teton County, Wyoming, has had such a process in place since 1982 that establishes parameters for such permits. Boulder, Colorado, has a detailed system that creates a protective solar envelope for every single-family dwelling unit and requires an analysis of any development that may impinge on that solar envelope (link to Boulder, Colorado, http://joomla.ci.boulder.co.us/files/PDS/codes/solrshad.pdf). In many communities, solar access is required to be available from 9:00 a.m. through 3:00 p.m. on December 21st, the day of the year with the longest shadows. The provision in this draft is written slightly less stringently, allowing some sunlight to be blocked by the neighbors provided sunlight is available at least 50% of the time on any day. For a detailed discussion of solar access laws in the United States with suggested model ordinance standards, see Kettles, A Comprehensive Review of Solar Access Laws in the United States (2008). http://www.solarabcs.org/about/publications/reports/solar-access/pdfs/Solaraccess-full.pdf. See also the California Solar Shade Control Act, Cal. Pub. Res. Code 25980-25986, which offers protection for solar collection systems from shading by trees and other structures.



Boulder Solar Envelope

1.3. SOLAR ARRAY

1.3.1. DEFINITION: SOLAR ARRAY

A "solar array" shall mean a free-standing, ground-mounted system consisting of a linked series of photovoltaic modules, the primary purpose of which is to provide for the collection, inversion, storage, and distribution of solar energy for electricity generation, space heating, space cooling, or water heating on-site. However, excess energy output may be delivered to a power grid to offset the cost of energy on-site. Solar arrays may be permitted as principal uses in the (e.g., industrial, office, large-lot residential) zone districts.


Residential solar array

1.3.2. STANDARDS

All solar arrays shall comply with the following requirements. If there is any conflict between the provisions of this section and any other requirements of the zoning or subdivision regulations the provisions of this section shall take precedence.

A. Use Classification

Solar arrays shall be treated as accessory uses in the following zone districts: (for example, insert residential and neighborhood-scale commercial districts). However, solar arrays are not subject to the dimensional requirements of the accessory land use and development provisions in any zone district or other section to the extent they conflict with this section. Solar arrays in the (insert districts) may be principal uses and as principal uses shall be processed according the procedures set forth in Section (insert applicable process such as special permit or site plan review process).

B. Residential Solar Arrays

1. A solar array serving a residential use shall not exceed a capacity of ten kilowatts per dwelling unit on the property.
2. A solar array shall not be located in the front yard between the principal structure(s) and the public right-of-way.
3. A solar array shall be located a minimum of five feet from all property lines and other structures.
4. An accessory solar array in any residential district shall not exceed the greater of one-half the footprint of the principal structure or 600 square feet, whichever is greater.
5. A residential solar array shall not exceed six feet in height

C. Non-Residential Solar Arrays

1. A solar array serving a non-residential use or mixed-use development shall exceed a capacity of one megawatt (MW).[8]
2. A solar array shall not be located in the front yard between the principal structure(s) and the public right-of-way, except in industrial districts.
3. A solar array shall be located a minimum of five feet from all property lines and other structures.
4. The size of accessory solar arrays in mixed-use and non-residential districts shall not exceed one-half of the footprint of the principal structure.
5. There shall be no size limit on solar arrays as a primary use on a site in any (insert appropriate zone district) district. However, the maximum lot coverage of any solar array shall not exceed 80 percent.
6. A non-residential solar array shall not exceed 20 feet in height.

[8] One megawatt is a unit for measuring power that is equivalent to one million watts. One MW is approximately equal to the power generated by 10 auto engines.

D. Code Compliance

Solar arrays shall comply with all applicable state building and electrical codes.

E. Solar Access Preservation

A property owner who has installed or intends to install a solar array shall be responsible for negotiating with other property owners in the vicinity for any necessary solar access preservation and shall record the restriction with the _____ (add appropriate agency or official).

F. Off-Street Parking and Loading Requirements

None.

1.4. SOLAR LOTS AND STRUCTURES

1.4.1. SOLAR-ORIENTED SUBDIVISIONS AND SINGLE FAMILY DWELLING UNITS

Solar-oriented subdivision and solar-oriented single family dwelling units are designed to obtain help maximize passive solar benefits. Solar-oriented design can produce savings in heating and cooling costs that range between 10 and 40 percent.[9]

A. Applicability

1. **Subdivisions of 10 or More Lots**

   The requirements of this section shall apply to subdivisions (including resubdivision) with 10 or more single family, single family attached, or two family residential lots.

2. **Subdivision of Fewer than 10 Lots**

   Subdivision of fewer than 10 lots shall meet the solar-oriented residential lots requirement of Section 1.4.1.C.1 to the maximum extent practicable[10] given zoning requirements, site location and topography, and available access. Where solar-oriented lots are not practicable, solar-oriented homes may still be provided.

B. Definition: Solar-Oriented Lot

A "solar-oriented lot" shall mean:

1. A lot with a front line oriented to within 30 degrees of a true east-west line. When the lot line abutting a street is curved, the "front lot line" shall mean

[9] Conn. Gen. Stat. Section 8-25b requires: "…any person submitting a plan for a subdivision to the [planning] commission under subsection (a) of this section to demonstrate to the commission that such person has considered, in developing the plan, using passive solar energy techniques which would not significantly increase the cost of the housing to the buyer, after tax credits, subsidies and exemptions. As used in this subsection and section 8-2, passive solar energy techniques mean site design techniques which maximize solar heat gain, minimize heat loss and provide thermal storage within a building during the heating season and minimize heat gain and provide for natural ventilation during the cooling season. The site design techniques shall include, but not be limited to: (1) House orientation; (2) street and lot layout; (3) vegetation; (4) natural and man-made topographical features; and (5) protection of solar access within the development." This section helps to implement the requirements of Section 8-25b.

[10] Maximum extent practicable is defined as: "under the circumstances, reasonable efforts have been undertaken to comply with the regulation, that the costs of compliance clearly outweigh the potential benefits to the public or would unreasonably burden the proposed project, and reasonable steps have been undertaken to minimize any potential harm or adverse impacts resulting from noncompliance with the regulation."

the straight line connecting ends of the curve. For a flag lot, the "front lot line" shall mean the lot line that is most parallel to the closest street, excluding the pole portion of the flag lot, or

2. A lot, when a straight line is drawn from a point midway between the side lot lines at the required front yard setback to a point midway between the side lot lines at the required rear yard setback, is oriented to within 30 degrees of true north along such line, or

3. A corner lot with a south lot line oriented to within 30 degrees of a true east-west line, where the south lot line adjoins a public street or permanently reserved open space and the abutting street right-of-way or open space has a minimum north-south dimension of at least 50 feet. For purposes of this definition, "permanently preserved open space' shall include, without limitation, parks, cemeteries, golf courses and similar outdoor recreation areas, drainage ditches and ponds, irrigation ditches and reservoirs, lakes, ponds, wetlands, open spaces reserved for use of residents of the development, and other similar permanent open space.

C. Standards

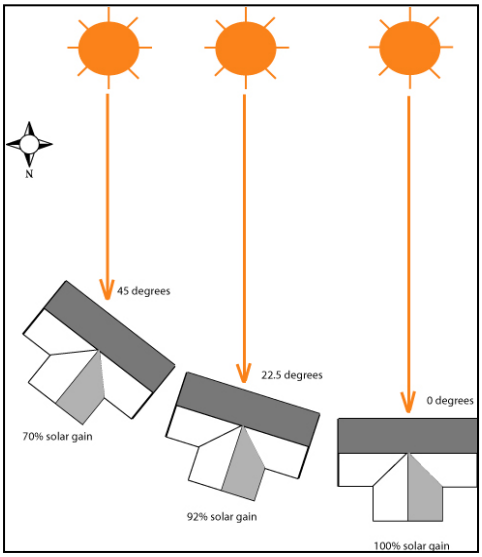
All developments with single-family lots subject to this section shall comply with the following requirements:

1. **Solar-Oriented Residential Lots**

   At least 25 percent of lots less than 15,000 square feet upon which single-family dwelling units are planned for construction shall conform to the definition of "solar-oriented lot" in order to preserve the potential for usage of solar energy systems.

2. **House Orientation**

   The long axis of all dwelling units on solar-oriented lots shall be oriented so that the long axis faces within 25 degrees of true south.



Preferred house orientation to maximize solar gain

3. **Street Layout**

   Where topographic, environmental, soil conditions, and existing street configurations permit, as determined by the _____ (insert name of local government), the predominant pattern of new streets in subdivisions subject to this section shall be laid out within 30 degrees of east-west orientation.

4. **Site Features**

   No vegetation or site features such as tall fences shall be planted, installed, or constructed on any lot in a new subdivision subject to this section that would block solar access to the south wall of a dwelling unit in the subdivision or would block sunlight 50 percent or more of the time on any

day of the year from the south facing roof of the dwelling. This provision shall not apply to the planting of vegetation or trees on any existing lot and shall not be interpreted to require the cutting down of existing trees or removal of existing vegetation.

5. **Modifications**

Where existing street and development patterns or unusual topographic, environmental, soil, and similar conditions exist that, as determined by the _____ (insert name of appropriate local official), make compliance with these provisions either physically or economically infeasible, the (insert name of appropriate local official) may modify the standards in this section. However, the modifications shall be the minimum necessary and shall maintain overall solar access in the subdivision.

Scale-Up Option—Solar-Ready Houses

An increasing number of communities such as Tucson, AZ, are requiring developers and home builders to build all or a percentage of the units in a project to be solar-ready. A "solar-ready" dwelling unit is a new home constructed with upgraded structural, mechanical, electrical, and plumbing systems that are capable of providing either solar hot-water heating or solar electric power. Initial studies show that these homes can command a higher initial sales price for the builder, hold higher resale value for the buyer, and can significantly lower energy bills. A solar-ready house typically costs only $300-500 more at the outset, the cost of which can be spread out over a 15-30 year mortgage period. To install wiring and pipes for a solar system after initial construction can cost from $2,000-5,000 and more depending on the structure ad size of the solar collection system.

1.4.2. SOLAR-READY DWELLING UNITS

A. Applicability

The requirements of this section shall apply to all new single family, single family attached and two family dwellings.

B. Definitions

1. **Solar-Ready Residential Dwelling**

A "solar-ready residential dwelling" shall mean a home that is equipped with upgraded plumbing, electric, roofing, and other systems to accommodate future installation and use of a solar energy system that provides either solar hot-water heating, solar electric power, or both.

2. **Solar Energy System**

A "solar energy system" shall mean a system including solar panels and related equipment, pipes, and wiring that converts sunlight to heat or electricity.

3. **Solar Hot-Water System**

A "solar hot-water system" shall mean a domestic hot water heating system consisting of solar energy collection equipment (typically roof-mounted panels), heat transfer through a heat exchanger, and hot water

storage.

4. **Solar Electric System**

A "solar electric system" shall mean a solar photovoltaic system that converts solar energy to electricity and consists of solar energy collection equipment (typically roof- or ground-mounted panels) and an inverter that changes DC to AC current or storage batteries. Such systems usually have a capacity of 2kW to 5kW.

C. Standards

1. **Requirement for Solar-Ready Dwelling Units**

All new single family, single family attached, and two family dwellings shall either come equipped with fully functioning solar hot-water and solar electric systems or shall include a method acceptable to the (insert name of local government) to allow for later installation of such systems.

2. **Solar Hot-Water Systems**

The builder shall provide for future installation of a solar hot-water system by:

a. Installing two labeled insulated pipes and a suitable sized conduit (for two pairs of monitoring and control wires) that run from the proposed water heater area through the roof and are capped, or installing a labeled sleeve or conduit of sufficient size to accommodate the two insulated pipes and wires. This option shall be available only if the sleeve or conduit can be run from the water heater area to the roof without bends or angles.

b. Specifying in construction plans the interior location of components such as a hot water heater or storage tank;

c. Providing extra plumbing valves and fittings on any installed hot water heater to accommodate a solar hot-water system;

d. Providing an electrical outlet at the planned solar hot water tank location; and

e. If a roof is the specified location for future installation of solar panels, structural support to accommodate such panels.

3. **Solar Electric (Photovoltaic) Systems**

The builder shall provide for future installation of a solar electric system by:

a. Submitting a site plan identifying a suitable location on site (e.g., on the roof or in a yard) in terms of size and orientation for the solar photovoltaic panels.

b. Specifying in construction plans a minimum area of four square feet suitable for the location of necessary equipment (e.g., inverters, meters, disconnect);

c. If a roof is the specified location for future installation, provide a roof

with a pitch, orientation, and structural support to accommodate the solar photovoltaic panels; and

d. Installing necessary labeled reserved electrical service and wiring for the solar electric system in the specified location.

1.5. SMALL WIND ENERGY SYSTEMS[11]

Small wind energy systems produce a limited amount of energy and are typically a single tower with a turbine designed for a single industrial, commercial, or residential use. These are not commercial wind energy systems that typically have much larger towers (300+ feet) and multiple turbines grouped as a "wind farm."

1.5.1. DEFINITION: SMALL WIND ENERGY SYSTEM

A "small wind energy system" shall mean a wind energy conversion system consisting of a wind turbine, a tower, and associated control or conversion electronics that has a rated capacity of not more than 100 kilowatts (kW) and that is intended primarily to reduce on-site consumption of utility power.

1.5.2. STANDARDS

All small wind energy systems shall comply with the following requirements. If there is any conflict between the provisions of this section and any other requirements of the zoning, site plan, and subdivision ordinances, the provisions of this section shall take precedence. Specifically, small wind energy systems are not subject to the height or dimensional requirements of the accessory land use and development provisions in any zone district or other section of these regulations, to the extent they conflict with this section.

Small wind energy system

A. Setback

The base of the tower shall be set back from all property lines, public right-of-ways, and public utility lines a distance equal to the total extended height (e.g., if on a roof, roof height + tower height) plus five feet. A tower may be allowed closer to a property line than its total extended height if the abutting property owner(s) grants written permission and the installation poses no interference with public utility lines or public road and rail right-of-ways. Guy wires and other support devices shall be setback at least five feet from all property lines.

[11] This section is based codes Clarion has drafted recently for communities such as Anchorage, Alaska, and Laramie, Wyoming, national research we have conducted on other recent local codes, and a model code prepared by the American Wind Energy Association.

B. Tower Height[12]

Option 1: Where the total extended height meets the sound (Section 1.5.2.C) and setback (Section 1.5.2.A) requirements of this section, there shall be no specific height limitation, except as imposed by Federal Aviation Administration (FAA) regulations per subsection J, below.

Option 2: The maximum height of any small wind energy system shall be the maximum height allowed in the zone district plus 50 feet.

C. Noise

Noise produced by the turbine under normal operating conditions, as measured at the property line of any adjacent property improved with a dwelling unit at the time of the issuance of the zoning certificate, shall not exceed 55 dBA for any period of time or shall comply with applicable state standards, whichever are more restrictive . The 55 dBA sound level may be exceeded during short-term events beyond the owner's control such as utility outages and/or severe wind storms.

D. Appearance, Color, and Finish[13]

The turbine and tower shall remain painted or finished in the color that was originally applied by the manufacturer. Bright, luminescent, or neon colors as determined by the (insert name of local government) are prohibited

E. Clearance[14]

The blade tip or vane of any small wind energy system shall have a minimum ground clearance of 15 feet as measured at the lowest point of the arc of the blades.

F. Signage Prohibited

All signs on a wind generator, tower, building, or other structure associated with a small wind energy system visible from any public road, other than the manufacturer's or installer's identification, appropriate warning signs, or owner identification, shall be prohibited.

G. Lighting

No illumination of the turbine or tower shall be allowed unless required by the FAA.

H. Access[15]

Any climbing foot pegs or rungs below 12 feet of a freestanding tower shall be removed to prevent unauthorized climbing. For lattice or guyed towers, sheets of

[12] The language in Option 1 allows for maximum flexibility. On small lots, setbacks required in Section 1.5.2.A effectively limit height. However, other communities have opted to impose specific height limitations. For example, the Washington County, Maryland, ordinance specifies that, "Small Wind Energy Systems attached to any building shall not exceed the permitted height for principle structures within the zoning district." Laramie, Wyoming, has tentatively approved a 75-foot height limit for small wind systems. The downside of imposing such restrictions is that the height limitations may reduce the effectiveness of the systems due to the inability to clear surrounding obstacles to wind flows. Most small wind systems are manufactured so that they do not exceed a total height of 120 feet. To be effective, turbines must be at least 25 to 35 feet above all surrounding obstacles such as trees and buildings within 300 feet and ideally twice that height above a potential obstacle.

[13] Some communities specify matte neutral colors (such as gray or white), which blend into a range of sky colors/conditions.

[14] Not all communities regulate clearance on private property. Some limit clearance regulations to public access areas.

[15] We do not recommend special fencing regulations, because fencing is not as effective or attractive as the suggested method to limit unauthorized access.

metal or wood or similar barriers shall be fastened to the bottom tower section such that it cannot readily be climbed.

I. Requirement for Engineered Drawings

Building permit applications for small wind energy systems shall be accompanied by standard drawings of the wind turbine structure and stamped engineered drawings of the tower, base, footings, and/or foundation as provided by the manufacturer.

J. Compliance with FAA Regulations

No small wind energy system shall be constructed, altered, or maintained so as to project above any of the imaginary airspace surfaces described in FAR Part 77 of the FAA guidance on airspace protection.

K. Compliance with Municipal Code

Small wind energy systems and all associated components shall comply with all applicable state building and electrical codes.

L. Utility Notification

No small wind energy system shall be installed until evidence has been submitted to the (insert name of local government) that the relevant electric utility company has been informed of the customer's intent to install an interconnected customer-owned generator. Off-grid systems shall be exempt from this requirement.

M. Abandonment

If a wind turbine is inoperable for six consecutive months the owner shall be notified that they must, within six months of receiving the notice, restore their system to operating condition. If the owner(s) fails to restore their system to operating condition within the six-month time frame, then the owner shall be required, at his or her expense, to remove the wind turbine from the tower for safety reasons. If the owner(s) fails to remove the wind turbine from the tower, the (insert name of local government) may pursue legal action to have the wind generator removed at the owner's expense.

N. Off-Street Parking and Loading Requirements

None.

Scale-Up Option--Incentives

Because alternative energy systems sometimes have higher up-front costs or involve technology that a developer may be unfamiliar with or be untested in the local market, many communities provide incentives to encourage their use. For example, Windsor provides an incentive of increased lot coverage limits for developments in industrial zones that use geothermal or solar energy. Many communities such as Asheville, NC, waive building permit and plan review fees for alternative energy systems or provide accelerated plan reviews. Others such as Portsmouth, VA, and Biloxi, MS, provide a variety of density, lot coverage, and other bonuses for developments that include alternative energy sources. One of the most important incentives the local governments in the region could offer would be to have consistent regional solar energy system permitting requirements as has been

done by Pima County, AZ, and its constituent municipalities, thereby eliminating confusing, overlapping, and contradictory regulatory requirements.

1.6. GROUND SOURCE HEAT PUMP SYSTEM

Ground source heat pump systems use the constant temperature of the earth to move heat into or out of a home or business.

1.6.1. DEFINITIONS

A. Geothermal Boreholes

A hole drilled or bored into the earth into which piping is inserted for use a closed vertical loop geothermal system.

B. Ground Source Heat Pump System

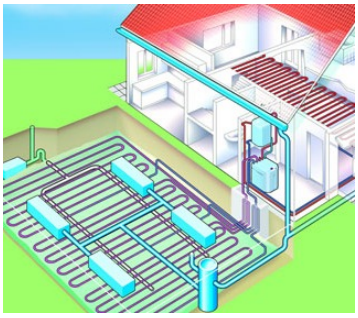
A system that uses the relatively constant temperature of the earth or a body of water to provide heating in the winter and cooling in the summer. System components include open or closed loops of pipe, coils or plates; a fluid that absorbs and transfers heat; a heat pump unit that processes heat for use or disperses heat for cooling; and an air distribution system.

C. Ground Source Heat Pump System, Closed Loop

A mechanism for heat exchange that circulates a heat transfer fluid, typically food-grade anti-freeze, through pipes or coils buried beneath the land surface or anchored to the bottom in a body of water.

D. Ground Source Heat Pump System, Horizontal

A closed loop ground source heat pump system where the loops or coils are installed horizontally in a trench or series of trenches.



E. Ground Source Heat Pump System, Open Loop

A system that uses ground water as a heat transfer fluid by drawing groundwater from a well to a heat pump and then discharging the water over land, directly in a water body or into an injection well.

F. Ground Source Heat Pump System, Vertical

A closed loop ground system heat pump system where the loops or coils are installed vertically in one or more borings below the land surface.

G. Heat Transfer Fluid

A non-toxic, biodegradable, circulating fluid such as potable water, a food-grade aqueous solution of propylene glycol not to exceed 20% by weight, or a food-grade aqueous solution of potassium acetate not to exceed 20% by weight.

1.6.2. REGULATIONS FOR GROUND SOURCE HEAT PUMP SYSTEMS

A. Permitted Districts

Ground source heat pump systems in accordance with the standards in this section are allowed as an accessory use in all zoning districts.

B. Installation of Vertical Systems

1. Vertical systems may only be installed by a geothermal installer or vertical closed loop (VCL) driller accredited by the International Ground Source Heat Pump Association (IGSHPA) or installer with an equivalent accreditation or certification from a nationally-recognized organization, as determined by the (insert name of appropriate decision-making official).

2. Detailed plans of a vertical system shall be reviewed and approved by the _____Department prior to installation. (Insert name of appropriate department such public works, utilities, planning department, etc.)

C. Standards

1. **System Requirements**

   a. Only closed loop ground source heat pump systems utilizing heat transfer fluids as defined in Section 1.6.1 are permitted. Open loop ground source heat systems are prohibited.[16]

   b. Ground source heat pumps and related boreholes shall conform to applicable industry standards, including those of the American National Standards Institute (ANSI), the International Ground Source Heat Pump Association (IGSHPA), the American Society for Testing and Materials (ASTM), the Air-Conditioning and Refrigeration Institute (ARI), or other similar certifying organization and shall comply with adopted state building code standards. The manufacturer specifications shall be submitted as part of the application.

2. **Depth**

   All horizontal closed loop systems shall be installed to no more than __ feet in depth.[17]

3. **Setbacks**

   a. All components of ground source heat pump systems including pumps, borings, tanks, and loops shall be setback at least five feet from all property lines.

   b. Above-ground equipment associated with ground source heat pumps shall not be installed in a front yard of any lot or in the side yard of a corner lot adjacent to a public right-of-way except in industrial districts.

   c. All parts of the heat pump system shall be located a minimum distance of 25 feet from any on-lot or adjacent lot wells.

[16] Open loop systems are typically permitted for agricultural uses where there is an on-site need for the water and in communities with numerous lakes and ponds. We have recommended prohibiting open loop systems but would like staff feedback about this choice.

[17] This number will depend on the local depth to groundwater. The loops should not extend into groundwater/aquifers.

d. Ground source heat pumps systems shall not be located in or encroach upon any public drainage, utility roadway, or trail easement.

4. **Screening**

Ground source heat pump systems are considered mechanical equipment and are subject to mechanical screening requirements of the zoning district.

D. Abandonment

If the ground source heat pump system remains nonfunctional or inoperative for a continuous period of one year, the system shall be deemed to be abandoned and shall constitute a public nuisance. The property owner shall shut down the system as follows:

1. The heat pump and any external mechanical equipment shall be removed.
2. Pipes or coils beneath the land surface shall be drained and filled with grout. The top of the pipe, coil, or boring shall be uncovered and grouted.

1.7. DISTRICT HEATING AND COOLING SYSTEMS

1.7.1. DEFINITIONS

A. District Heating and Cooling Facility

Any property or structure used as an integral part of a district heating or cooling system.

B. District Heating and Cooling System

Any system consisting of a pipeline or network, which may be connected to a heating or cooling source, that provides hot water, chilled water, or steam to two (2) or more users

1.7.2. SPECIAL USE PERMIT

A district heating and cooling facility or system may be allowed by _____ (insert decision-making body) as a special use if it complies with the applicable standards set forth in Section 1.7.3 and all requirements as provided in Section _____ of these regulations (insert cross-reference to generally applicable special or conditional permit requirements).

1.7.3. REGULATIONS FOR DISTRICT HEATING AND COOLING SYSTEMS AND FACILITIES

A. Residential Zone Districts

District heating and cooling facilities located in residential districts shall comply with the following standards:

1. District heating and cooling facilities shall be allowed only in the _____residential zone districts.
2. No facility in a residential district shall exceed a capacity of 1MW.
3. The maximum daily amount of fuels that may be brought into a facility located in a

A district heating facility in Denmark

residential district shall not exceed 50 tons.

4. Underground fuel storage tanks associated with a facility in a residential district shall be permitted.

5. The minimum lot area shall be 20,000 square feet.

6. The total lot coverage of all structures shall not be more than 50 percent of the lot area.

7. The minimum setback distance of any facility or system shall be 100 feet from any adjacent property line.

8. All facilities or systems shall be screened from adjacent residential, commercial, or institutional property by a solid fence or planting screen that shall provide year-round screening with a height of at least six feet.

9. All activity associated with the facility shall be wholly within an enclosed structure. There shall be no open storage of materials or fuel associated with the facility.

10. Parking and loading facilities shall be provided as set forth in Section____. (add reference to parking and loading regulations—calibrate to number of employees and expected size of fuel shipment vehicles).

11. Noise from the facility shall not exceed 55dB (day) and 45dB (night) measured at the property line.

12. All lighting associated with the facility shall have full cut-off shielding.

13. Control of air pollution shall be in accordance with (add reference to local or state air pollution standards).

B. Commercial and Institutional Zone Districts

District heating and cooling facilities located in commercial and institutional zone districts shall comply with the following standards:

1. District heating and cooling facilities shall be allowed only in the _____residential zone districts.

2. No facility in a commercial or institutional zone district shall exceed a capacity of 20MW.

3. The maximum daily amount of fuels that may be brought into a facility located in a residential district shall not exceed 100 tons.

4. Underground fuel storage tanks associated with a facility shall be permitted.

5. The minimum lot area shall be 20,000 square feet.

6. The total lot coverage of all structures shall not be more than 50 percent of the lot area.

7. The minimum setback distance of any facility or system shall be 100 feet from any adjacent property line.

8. All facilities or systems shall be screened from adjacent residential, commercial, or institutional property by a solid fence or planting screen that shall provide year-round screening with a height of at least six feet.

9. All activity associated with the facility shall be wholly within an enclosed structure. There shall be no open storage of materials or fuel associated with the facility.

10. Parking and loading facilities shall be provided as set forth in Section____. (add reference to parking and loading regulations—calibrate to number of employees and expected size of fuel shipment vehicles).

11. Noise from the facility shall not exceed 55dB (day) and 45dB (night) measured at the property line.

12. All lighting associated with the facility shall have full cut-off shielding.

13. Control of air pollution shall be in accordance with (add reference to local or state air pollution standards).

C. Industrial Districts

District heating and cooling facilities located in industrial zone districts shall comply with the following standards:

1. District heating and cooling facilities shall be allowed only in the _____industrial zone districts.

2. There shall be no maximum MW capacity limit in industrial zone districts.

3. There shall be no maximum daily limit on the amount of fuels that may be brought into a facility located in an industrial zone district.

4. Underground fuel storage tanks associated with a facility in an industrial zone district shall be permitted.

5. The minimum lot area shall be 40,000 square feet.

6. The total lot coverage of all structures shall not be more than 75 percent of the lot area.

7. The minimum setback distance of any facility or system shall be 100 feet from any adjacent property line of an industrial use and 200 feet from any adjacent property line of a residential or commercial use.

8. All facilities or systems shall be screened from adjacent residential, commercial, or institutional use by a solid fence or planting screen that shall provide year-round screening with a height of at least six feet.

9. All activity associated with the facility shall be wholly within an enclosed structure. There shall be no open storage of materials or fuel associated with the facility.

10. Parking and loading facilities shall be provided as set forth in Section____. (add reference to parking and loading regulations—calibrate to number of employees and expected size of fuel shipment vehicles).

11. Noise from the facility shall not exceed 55dB (day) and 45dB (night) measured at the property line of any adjacent residential, commercial, or institutional use or shall comply with applicable state standards, whichever are more restrictive.

12. All lighting associated with the facility shall have full cut-off shielding.

13. Control of air pollution shall be in accordance with (add reference to local or state air pollution standards).