Section 8
Energy and Energy Conservation

Energy powers our way of life. It heats our homes, cooks our food, allows us to travel and drives our economy. Where available in sufficient amounts, it allows industry and commerce to flourish. Where derived from alternative energies or conserved, it lessens the impact we make on our environment and saves us money. Its role and impact on our community should be considered when making land-use, development, transportation or conservation decisions.

Energy Infrastructure

As is typical for rural New England towns, most of Middlefield's homes, businesses and industries are heated with electricity, heating oil or bottled gas. The town currently has limited energy resources and there are no plans to develop generation, supply or distribution facilities. There are currently no consumer-accessible natural gas pipelines within the town and none is proposed to be constructed in the foreseeable future. The town has no micro-grids; although such a grid could be beneficial during severe storms should utility power be unavailable. None of the town's automotive filling stations are equipped with emergency generators, which could permit these facilities to continue dispensing motor fuels during severe storms should utility power be unavailable. The town should conduct a detailed cost analysis regarding the possible installation of a micro-grid which would serve the center area of town, including the Town Hall, Library, Public Safety Complex and the Community Center. The town should also work with the owners of the automotive filling stations in Middlefield to install emergency generators.

Renewable and Alternative Energies

Middlefield homeowners, from 2014 to May of 2016, have installed renewable solar energy. The town currently has no large-scale solar farm; however, in future years, the cost of converting solar energy into electrical energy is expected to be more competitive with utility-generated electricity. It is expected to lead to an increase in the placement of solar panels. The town should identify a suitable location for the installation of a large-scale solar farm to take advantage of virtual net metering revenues. These revenues can offset the cost of electric energy for the town's municipal buildings.

Another renewable energy which is rapidly gaining popularity for heating or cooling is low-grade geothermal energy. Geothermal systems harness the power of the earth's relatively constant and perpetual subterranean temperatures, using the earth as a heat source in the winter and heat sink in the summer. The town should consider using low-grade geothermal systems for heating and cooling its municipal buildings. Because there are geothermal systems which use liquids other than water as a heat transfer fluid, the P&Z Commission should work with the town's Building Official and Health Director to promulgate regulations which ensure that groundwater aquifers are not contaminated by heat transfer chemicals used with geothermal systems.

Energy Efficiency and Conservation Measures

The efficient conversion of energy from one form to another minimizes the costs associated with its use. Improved efficiency and conservation measures lessen the impact to our environment as fewer power plants are needed to run to meet our needs. Improved efficiency and conservation measures also further our county's goal of energy independence.

Efficiency can be described mathematically as the output divided by the input, expressed in percent. A furnace is having an efficiency rating of 88 percent converts approximately 88 percent of its fuel (input) to usable heat (output). A more efficient furnace, with an efficiency rating of 90 percent, may cost more to purchase initially; however, it will consume less fuel to produce the same amount of heat over its lifetime. Since the cost of energy consumed can be many times the purchase price (a $4,000 furnace can easily consume $40,000 of fuel during its lifetime), purchasing more efficient heating, air conditioning or lighting equipment is a sensible investment.

The same is true of building materials, such as insulation, siding and windows. Some materials offer average efficiency ratings; while others have higher efficiency ratings. Materials with higher efficiency ratings cost more because they save more. Since these savings occur over the lifetime of the material, installing higher-efficiency materials during construction provides the highest returns.

Insulation, Windows and Air Ingress/Egress

Middlefield has some older homes, some of which may be considered historic. Many of these older homes were constructed with the materials of the day which provided much lower values of insulation than do modern materials. Some of these older buildings were constructed with little to no insulation between the inner and outer walls or with windows constructed from a single layer of thin glass. In some cases, the piping used for the transfer of steam or hot water is poorly insulated.

These historical and older homes may have openings where cold air can enter. Buildings and homes that are not properly sealed or insulated are at a higher risk for the ingress of cold, damp air and the resulting mold growth. Poorly-insulated homes and buildings with air leaks use more energy in both winter and summer months as heating and air conditioning systems operate more often to make up for the air leaks and heat losses.

Buildings which suffer from inadequate insulation, older windows or air leaks can be sealed and fitted with a variety of high-performance insulation materials and windows. The town should contract with a Qualified Energy Assessor (QEA) to perform an in-depth audit of all municipal buildings; identifying needed repairs, specific areas for improvement and energy-efficiency projects to be funded.

Heating Systems

Furnaces and boilers should be cleaned and tuned annually to maximize efficiency and reduce emissions. In hot water baseboard systems, pockets of air can develop in the piping system; inhibiting the flow of heated water and resulting in inadequate levels of heat for its occupants. As the boiler continues to run, in an attempt to reach the setting of the thermostat, additional energy is wasted. By removing this trapped air, efficiency can be restored. As part of the annual cleaning and tuning procedure, the air pockets should be removed. Also, for forced hot air systems, particulate filters should be changed, dampers adjusted and ducts checked for leakage.

Programmable Thermostats

Homes, businesses and municipal buildings which are equipped with simple on-off thermostats should have them replaced with programmable thermostats which can memorize the preferred times and temperatures for heating and cooling systems. Programmable thermostats typically save enough energy to cover their cost (including installation) in less than one year.

Domestic Hot Water Systems

In many homes and businesses, water is heated for domestic (e.g. faucets, baths, dishwashers, etc.) uses and remains cooling in a large storage tank, until needed. The practice of heating 40 to 80 gallons of water in advance of its use is wasteful. A more efficient solution is to heat only the water being used. This can be accomplished by installing one or more instantaneous ("on-demand") hot water heaters.

Lighting Systems

A vast range of lighting sources is now available; having various efficiencies, life expectancies, illumination qualities and purchase prices. Among the very best are those which are designed around the Light-Emitting Diode (LED). Modern LED lamps and fixtures produce high-quality illumination while consuming just 25 to 35 percent of the energy used by traditional light sources. Environmentally, LEDs are superior to fluorescent lamps and CFLs, which both contain trace amounts of mercury.

From a maintenance perspective, LED lamps and fixtures are far superior to other light sources. Their exceptionally long life and minimal maintenance requirements nearly eliminate routine maintenance costs. For these reasons, the town should require that all new municipal buildings and major upgrades to its facilities include the use of energy-efficient lighting systems.

The least expensive watt is the one which is never used. Thanks to technological advances in occupancy controls, dusk-to-dawn and ambient light sensing, the cost of operating lighting systems can be a fraction of its traditional costs. Where possible, the town should promote the use of these technologies in municipal, residential, commercial and industrial applications.

Energy Audits and Public Outreach

An energy audit (energy assessment) provides a thorough accounting of the energy used by a building or process. Energy audits help identify wasted energy and specific areas for improvement. Annually, the town should contract with a Qualified Energy Assessor (QEA) to perform an in-depth audit of its municipal buildings; identifying needed repairs, specific areas for improvement and energy-efficiency projects which should be funded. Also, the town should sponsor a public seminar on energy-conservation methods for home and business owners.

Land-Use Practices Which Reduce Energy Consumption

Middlefield can improve energy conservation efforts through land-use practices which promote efficiency and conservation. These practices could include promoting the construction of smaller homes, allowing higher-density or mixed-use communities and considering transit-oriented development patterns. Smaller homes tend to use less energy than do larger homes. Higher-density developments typically use less energy than lower-density developments. Mixed-use buildings and communities offer synergies concerning heating and cooling and transit-oriented development allows public transportation systems to serve more individuals in a more efficient way.

The town should review and, if necessary, revise its land-use regulations to accommodate the construction of smaller homes and encourage higher density development in areas where septic/soil limitations are not problematic. Mixed-use and transit-oriented development should also be considered, where appropriate.

Building Placement, Orientation and Design

Building placement and design can have a dramatic effect on energy consumption over the life of a building. These factors should be considered before new construction or major renovations. The town's Building Department and Land Use Commissions should provide information packets or consider regulations for builders and developers to consider energy use when determining building placement, orientation and design. The following guidelines may be considered.

The relative position of the sun is a major factor in heat gain in buildings, which makes the accurate orientation of the building a fundamental consideration in passive solar construction. Builders should note that these directions are given about the sun, and not magnetic north, which can vary significantly from the sun's actual position. Magnetic north, as read from a compass, can still be used as a reference if the builder adjusts the figure based on the location-specific magnetic variation which can be found on publicly-available maps.

A rectangular house's ridgeline should run east-to-west to maximize the length (exposure) of its southern side, which should incorporate several windows in its design. Fewer windows should be located on the northern side of the house, where the summer sun can be intense. A deep roof overhang can shade the few windows in this area, as can different types of shade trees and bushes. Homes oriented toward the sun without any additional solar features save between 10 and 20 percent and can save up to 40 percent on home heating.

To maximize heat gain, builders should orient the floor plan (not merely the building profile) toward the sun. Rooms which are more frequently used , such as the kitchen and living room, should be located on the southern side of the home where possible. Homeowners appreciate having sun rays in the winter and relief from the sun in the summer. Patios and decks should be built on the south side of the house, where direct sunlight will permit their use for more hours during the day and more days during the year. Likewise, the garage, laundry room and other areas that are less frequently used should be situated at the northern part of the house where they will act as buffers against the cold winter winds.

Energy-Efficiency Initiatives and Construction Standards

There are some new techniques that can be used when constructing new buildings or reconstructing existing buildings to make them more energy efficient. Part of this increased efficiency can be realized through building construction techniques and part can come through the efficiency of the appliances and systems used for heating, ventilation and air conditioning (HVAC). The standards which are commonly used to rate the efficiency of buildings, appliances and HVAC systems include:

- *Leadership in Energy and Environmental Design (LEED)*: Rating system of the U.S. Green Building Council, which provides a group of standards for environmentally-sustainable building construction. The LEED standards are used throughout the United States.

- *Seasonal Energy Efficiency Ratio (SEER):* Metric used to measure how much cooling an air conditioner puts out for each unit of energy it consumes. The higher the SEER rating, the more efficiently an air conditioner operates.

- *Energy Star:* An international standard for energy-efficient appliances, consumer products, building materials and other products. Devices carrying the *Energy Star* logo typically reduce energy by between 20 and 30 percent.

- *Energize Connecticut:* The Energize Connecticut initiative helps Connecticut residents and businesses reduce their energy usage through services, rebates and financing for energy-efficiency surveys and projects. This program is funded by all ratepayers through a charge on their electric bills and should be utilized when possible.

Energy-Efficient Appliances

Significant energy savings can be achieved by purchasing higher-efficiency appliances. As the following table shows, approximately 27 percent of the electricity supplied to the average household is consumed by appliances.

How is electricity used in U.S. homes?

Estimated U.S. residential electricity consumption (2014)

End-use	**Share of total**
Space cooling	13%
Lighting	11%
Water heating	9%
Space heating	9%
Refrigeration	7%
Televisions and related equipment[1]	7%
Clothes dryers	4%
Furnace fans and boiler circulation pumps	3%
Computers and related equipment[2]	2%
Cooking	2%
Dishwashers[3]	2%
Freezers	2%
Clothes washers[3]	1%
Other uses[4]	27%

[1] Includes televisions, set-top boxes, home theater systems, DVD players and video game consoles.
[2] Includes monitors and networking equipment.
[3] Does not include water heating.
[4] Includes small electric devices, heating elements, and motors not listed above. Does not include electric vehicle charging

Source: U.S. Energy Administration - U.S. Department of Energy

Goals

- Consider installing a micro-grid to serve the central area of town; including Town Hall, Library, Public Safety Complex and one or more school buildings in an emergency.

- Advocate for one or more automotive filling stations to install emergency generators to facilitate the dispensing of motor fuels during periods when utility power is unavailable.

- Identify a suitable location for the installation of a large-scale solar farm to take advantage of virtual net metering revenues.

- Consider using low-grade geothermal systems for heating or cooling municipal buildings.

- Promulgate regulations which ensure that groundwater aquifers are not contaminated by the heat transfer chemicals of geothermal systems.

- Contract annually with a Qualified Energy Assessor (QEA) to perform an in-depth audit of municipal buildings; identifying needed repairs, specific areas for improvement and energy-efficiency projects to be funded.

- Sponsor a public seminar on energy-conservation methods for homes and businesses.

- Communicate to the public that, despite a higher initial cost, the purchase of high-efficiency building materials, appliances, heating, air conditioning and lighting equipment is a wise investment.

- Require that all new municipal buildings and major upgrades to its municipal facilities include the use of energy-efficient lighting systems, occupancy controls, ambient lighting and dusk-to-dawn sensing equipment; and promote the use of these technologies in residential, commercial and industrial applications.

- Review, and, if necessary, revise building and land-use regulations to accommodate the construction of smaller homes; encourage higher-density development in areas where septic/soil limitations are not problematic; consider compact mixed-use communities and transit-oriented development patterns.

- Require that builders and developers consider energy use when determining building placement, orientation and design.