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Renewable Energy: A Primer for Municipal Leaders

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There's certainly a lot of "buzz" today about renewable energy. It's a topic that's on the minds of many municipal officials as they seek to contain and reduce ever-rising utility costs. The fact that we, as a region, pay more for electricity than any other region in the United States is a harsh reality every New England government center must face. And it seems the slightest hint of turmoil in the Middle East, or the threat of a hurricane in the Gulf of Mexico, is enough to send the price of fuel-the price of energy-skyrocketing.

So what's a municipal official to do? How can you begin to make sense of the various renewable energy technologies that have suddenly become part of our vernacular? What's "PV"? How does geothermal both heat and cool a building? What is cogeneration, and can it work in conjunction with solar power?

This article seeks to answer your initial questions and bring focus and clarity to the renewable energy discussion. The primary energy-producing technologies (solar, geothermal, and cogeneration) will be examined in light of potential municipal applications. Perhaps, armed with this information, you'll someday utilize one of these energy sources to save money and demonstrate environmental stewardship within your community. So, let's begin.

Solar

If you've had the good fortune of traveling to Germany recently, you'll recall the appearance of solar panels on many residential, commercial and municipal buildings. Germany has embraced solar power like no other nation on Earth. But here's a little secret you should know: the Germans receive a smaller solar resource than we do, right here, in New Hampshire. They get approximately three hours of average, peak sunlight per day. In New Hampshire, we receive up to 4.6 hours. So we get more effective sunlight than the world's leading user of solar energy!

With increased awareness of this resource, municipalities throughout the state are rapidly embracing solar energy. There are different kinds of solar power for your municipality to consider. Here we'll discuss two: solar photovoltaic and solar thermal. Each represents a different way to harness the energy of the sun for your community. In that sense, solar energy can be both site-specific and application-specific.

Solar Photovoltaic

Solar photovoltaic ("PV") modules produce electricity from the sun and have become iconic symbols of the renewable energy industry. PV modules trace their origin to the exploration of outer space, yet they represent a down-to-earth future that's cleaner, brighter and more secure.

Photovoltaic modules or "panels" can be mounted virtually anywhere, in any location or climate, as long as there's unrestricted access to the southern sky. The mounting methodologies can be equally varied. PV panels can be mounted on a pitched roof, a flat roof, on a pole, on a frame on the ground, and even imbedded within the roof or facade of a building. As long as they can be bathed in sunshine for a good portion of the day, a PV panel will produce tremendous amounts of electrical power for 30-plus years.

A photovoltaic panel is, in many respects, a perfect machine. It has no moving parts. It simply basks in sunshine and efficiently uses photons of light (packets of energy from the sun) to knock loose electrons from its silicon surface. Those liberated electrons easily jump onto ultra thin wires that are threaded throughout the panel. As you'll recall from high school physics, once you have electrons flowing along a wire, you have current. You have electricity. That electricity is in the form of direct current (DC), so we must convert the electricity to alternating current (AC) in order to make it compatible with a building's electronic devices and with the utility grid.

Any electricity produced can be used on-site to power the myriad electronic devices that we've come to rely on at both home and work. If the story ended there, with an understanding of free electricity from the sun, it would be a good thing. But it gets better. Excess or unused electricity is automatically fed onto the grid. And when excess electricity flows through the meter out to the grid, it effectively (and visually) spins the meter backwards for full credit.

So if, for example, your city or town is paying ¢.10 per kWh, the municipality will receive a credit of ¢.10 per kWh on the next electric utility statement. That process is called "net metering," and it's created a great deal of interest in renewable energy technologies that generate electricity. It means your municipality will not only save money by generating free electricity from the sun, but there's the added potential to further reduce utility bills by "banking" excess electricity on the grid.

Other benefits of PV are public awareness and education. PV arrays have the ability to share their production numbers with the Internet. That makes it easy for interested citizens to monitor the amount of energy being produced and the carbon offset. Some programs will even convert the carbon offset to the equivalent of cars removed from the roads and trees planted. A PV array can be a wonderful teaching tool as well. It demonstrates good stewardship of the planet and charts a course toward a sustainable energy future for children to learn about and pursue.

Photovoltaic panels can be utilized in any municipal location where electricity is needed. From water pumping stations to police stations, city halls to town halls, fire departments to recreation departments, ballparks to parking lots; there's an application for free electricity from the sun in every municipality. Payback is measured in a few short years, and the return on investment beats nearly every financial instrument available. It's no wonder more and more municipalities are installing and reaping the rewards of this most flexible of all renewable energy technologies: photovoltaics.

Solar Thermal

A solar thermal array consists of a series of collectors mounted on the south-facing roof of a building. Small tubes carry a mix of propylene glycol (food-grade antifreeze) and distilled water throughout each collector. The fluid easily absorbs the heat energy from the sun and then makes its way, through insulated pipes, to the basement or equipment room. There the fluid sheds or "exchanges" its heat with potable water in a super-insulated hot water storage tank. Then the fluid is pumped back to the collectors on the roof. This process forms an endless loop, allowing the collector fluid to continually build the temperature of the potable water in the storage tank.

A remarkable fact is the sun has enough energy to heat the water to almost 200ºF in the summer. And, even in the middle of a New Hampshire winter, the fluid traveling down from the roof-mounted collectors may be over 100ºF. That means the sun can meet many of your hot water needs … for free!

Solar thermal energy can be utilized virtually anywhere there's a need for domestic hot water and unrestricted access to the southern sky. Buildings that have shower facilities, sinks, dishwashers or washing machines are all prime candidates for free hot water from the sun. The operating expense of a community pool can also be significantly reduced by harvesting the sun's warming rays, instead of burning greenhouse gas-emitting fossil fuels to heat the water.

By utilizing solar thermal energy, a municipality can help save the planet and taxpayer dollars at the same time. The reduction in greenhouse gas emissions and fuel costs can be significant. As a result, solar thermal energy is a great way to demonstrate environmental stewardship while enjoying a fast payback. That's music to the ears of tree-huggers and penny-pinchers alike.

Geothermal

If you've ever visited the Merrimack County Nursing Home, Atkinson Town Hall, Gilford Public Library or Keene Department of Public Works, you'll recall the comfortable interior temperature. There are no cold or hot spots in the buildings. That's because each is heated and cooled by a geothermal space conditioning system.

A geothermal system takes advantage of the constant temperature of the soil (not the earth's core) to provide heating, cooling and hot water. It's based on the principal solar energy captured

and stored just below the surface. Dig down a few feet beneath your feet, and you'll be surprised to find the soil and adjacent water table remain a consistent 48-50ºF.

Think of a geothermal system as a giant, reversible refrigerator. A refrigerator uses a compressor and refrigerant to absorb heat from the contents inside, and then ejects that heat out the back or bottom of the appliance. A geothermal system achieves the same objective but with a twist: the heat absorbed from the earth is used to warm a building. In the summer, the process is reversed and heat is moved or shed from the building to the earth.

There are currently more than 900,000 geothermal installations in the United States alone. They all consist of a grid of buried or submerged polyethylene plastic pipe, called a "heat exchanger," through which a fluid is pumped. It's the fluid that easily absorbs heat energy and either transports it to the building to provide heating, or deposits heat back into the soil to provide cooling.

Based on budget, soil conditions, available land and building needs, a municipal leader will choose from four main types of heat exchanger. A geothermal specialist will assist in selecting the appropriate heat exchanger, as well as the associated heat pump and heating/cooling delivery system. The specialist should perform a "Manual-J" calculation to make the correct recommendation and accurately size the system to meet the anticipated heating and cooling demands.

A geothermal system has numerous benefits, not the least of which is a potential 70 percent reduction in energy costs. And, with a life expectancy of 20-25 years, a geothermal system will provide a reliable service that's nearly double a traditional, fossil fuel-burning system.

No other form of building heating or cooling comes close to the efficiency and quiet comfort associated with geothermal technology. It's no wonder so many municipal, county and state facilities are now heated and cooled by energy captured from beneath the earth's surface.

Cogeneration

Cogeneration, commonly referred to as Combined Heat and Power or CHP, may not necessarily be a form of renewable energy. It frequently uses propane or natural gas as a primary fuel source to become an "alternative" energy technology. However, if its fuel is a derivative of biomass, a cogeneration system truly becomes "renewable."

A cogeneration system is very thermodynamically efficient. It derives two forms of energy (electricity and heat) from a single source of fuel. Typically, whenever electricity is produced, the byproduct (waste heat) is ejected. With a cogeneration system, the waste heat from the generator is captured and used to provide both space heating and hot water. So a facility with a CHP system generates both electricity and heat at the same time, using the same fuel. A high-efficiency boiler or furnace is associated with a cogeneration system. It provides additional heat when outdoor temperatures plunge and the waste heat from the generator is insufficient to heat the building. The boiler (or a hot water heater) also performs the role of providing supplemental hot water when demand is high for showers, washing machines, dishwashers, etc.

A solar thermal system can be deployed with a CHP system as well. The free hot water associated with the sun's warming rays will allow the boiler or hot water heater to sit idle during the summer months, as well as during the late spring and early fall. This saves the municipality money and extends the life of the equipment for additional, long-term savings.

Cogeneration provides 11 percent of the energy needs of Europe. As a matter of fact, Germany has mandated 25 percent of their energy needs will be met with this technology by 2020. It's encouraging to see cogeneration finally being embraced here in America, too. The towns of Epping and Hampton Falls are leading the way. Undoubtedly, more municipalities will follow. The future of cogeneration is bright … and bright for those who utilize it.

The Future is Bright

There are few programs a municipal leader can initiate that have the potential to save taxpayer money and create community pride like renewable energy. Harvesting free energy from the sun and the earth makes both fiscal and political good sense.

As we hurtle headlong toward a near-term future, where fossil fuels are increasingly rare and expensive, we will have to find other ways to heat, cool and light our world. The future is uncertain and, for many, fraught with danger when one considers our nation's dependence upon foreign sources of energy. But, it doesn't have to be that way. The future can be safer and more secure if we only have the wisdom-and the will-to lead our communities in a different direction. Yes, with renewable energy, the future is bright.

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