7.2 On-site Renewable Energy Generation

Part Two: Clean Energy Best Practices for Local Governments							
6.0 Energy Efficiency	7.0 Energy Supply					8.0 Transportation Technologies and Programs	9.0 Urban Planning and Design
	7.1 Green Power Procurement	7.2 On-site Renewable Energy Generation	7.3 Combined Heat and Power	7.4 Landfill Methane Utilization	7.5 Working with Utilities		

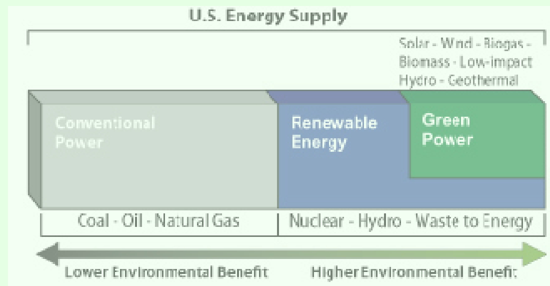
7.2.1 Overview

Many local governments are generating renewable energy at their own facilities and working with local businesses and residents to help them do the same at their offices and homes. By installing equipment that captures energy from sunlight, wind, water, and other renewable energy sources, local governments and communities can achieve substantial energy, environmental, and economic benefits. Installing on-site renewable energy generation systems at municipal facilities — and providing incentives to local businesses and residents to do the same — can also be an effective way to demonstrate a local government's commitment to meeting community greenhouse gas (GHG) emission reduction goals.

This section highlights local government and community benefits associated with on-site renewable energy generation.[1] It also provides information on how local governments have planned and implemented on-site renewable energy generation activities at their facilities and throughout the community, and offers sources of funding and case studies. Additional examples and information resources are presented in Table 7.2.2, *On-site Renewable Energy Generation: Examples and Information Resources* (see page 24).

Renewable Energy and Green Power

Generating renewable energy on-site can provide a source of green power. Green power is a subset of renewable energy and represents those renewable energy resources and technologies that provide the highest environmental benefit. Green power is produced from solar, wind, geothermal, biogas, biomass, and low-impact hydro.



Green power sources produce electricity with an environmental profile superior to conventional power technologies and produce no anthropogenic greenhouse gas emissions. EPA requires that green power sources must also have been built since the beginning of the voluntary market in order to support "new" renewable energy development (U.S. EPA, 2007e).*

* January 1, 1997 is considered a definitive point in time when green power facilities could be adequately identified as having been developed to serve the green power marketplace. Green power facilities placed into service after January 1, 1997 are said to produce "new" renewable energy. The "new" criterion addresses the additionality requirement for the voluntary market (U.S. EPA, 2007f).

[1] Because generating renewable energy can provide a source of green power, the content of this section can be considered with the information presented in Section 7.1, *Green Power Procurement*, which described other options for obtaining green power.

7.2.2 Benefits of On-site Renewable Energy Generation

On-site renewable energy generation can produce significant energy, environmental, and economic benefits for a local government and the community, including to:

- *Demonstrate leadership.* Generating renewable energy at local government facilities can be an effective and visible way of demonstrating environmental leadership to the public. In 2003, Lenox, Iowa purchased and installed a 750 kW wind turbine to produce electricity for its own facilities at about the same time that the town's municipal electric utility began offering customers the option of purchasing renewable energy. When nearly 13% of the city's households enrolled to purchase renewable energy, significantly higher than the national average of 1% to 3%, the city attributed the success of the program to the increased public awareness generated by the new turbine (Energy Services Bulletin, 2004).

  Installing renewable energy generation systems at facilities that are frequently visited by the public can lead to greater community awareness of local government leadership and the benefits of clean energy activities. Highland Beach, Maryland, for example, is demonstrating leadership by generating 100% of the energy used by its town hall from renewable resources. The town hall uses geothermal energy to reduce heating and cooling loads, and solar photovoltaic panels produce enough power to meet the balance of the building's energy needs (Highland Beach, 2006).

Generation Capacity and Production

Electricity production and consumption (measured in kWh) are a function of generation capacity (measured in kW) and time (measured in hours). System generation capacity depends on a site-specific capacity factor, which describes the system's actual energy output divided by the output if the system operated at full capacity. Electricity production can be calculated as follows:

Electricity production (kWh) =

Capacity (kW) x Capacity factor x Time (hours)

Solar photovoltaic panels typically have capacity factors between 0.07 and 0.17. For most wind turbines, the capacity factor is between 0.25 and 0.30 (*Hull 1* in Hull, Massachusetts, for example, operates at 0.27). Most fossil fuel power plants have capacity factors near 0.28.

As an example, the annual electricity production of a 10 kW PV system with a capacity factor of 0.15 would be calculated as follows:

10 kW x 0.15 x 8,760 hours = 13,140 kWh per year (36 kWh per day)

Sources: EIA, 2007; AWEA, 2007; CEC, 2007a; U.S. DOE, 2007e.

Reducing Grid-based Electricity Purchases

Obtaining electricity from on-site sources can produce significant cost savings. A wind turbine with a generation capacity of 10-kW located at a site with average wind speeds of 12 miles per hour can produce approximately 10,000 kWh annually, enough to power a small building. Assuming an average price for conventional electricity of 9¢ per kWh (as of June 2007), the wind turbine would reduce annual grid-based electricity costs by approximately $900. With installed costs for turbines ranging between $1,000 and $5,000 per kW capacity, these savings could mean a simple payback period of less than six years.

Sources: EIA, 2007; AWEA, 2007.

- *Hedge against financial risks.* On-site renewable energy generation systems can reduce local government energy costs by decreasing susceptibility to fossil fuel price volatility, which can lead to higher prices for grid-based electricity. This allows local governments to better anticipate and plan for future energy expenditures (U.S. EPA, 2004; AWEA, 2007). In 2003, Auburn, New York installed a geothermal system to heat and cool its historic City Hall at an installed cost of approximately $1 million, comparable to the cost of a conventional heating and cooling system. The geothermal system, which was installed in a way that blended with the historic building's internal and external architecture, is expected to save approximately $250,000 in operating and maintenance costs (including energy costs) over its lifetime due to expected increases in conventional energy prices (Energy Vortex, 2003).

- *Reduce emissions of GHGs and other pollutants.* Substituting renewable energy for conventional energy can substantially reduce the emissions of GHGs and other pollutants that result from local government activities. Fossil fuel combustion for electricity generation accounts for 67% of the nation's SO_x emissions, 23% of the nation's NO_x emissions, and 40% of the nation's CO_2 emissions, which can lead to smog and acid rain, and increase the risk of climate change (U.S. EPA, 2008). Many local governments have developed plans with goals for reducing GHG emissions resulting from government and community activities. By generating renewable energy on-site, local governments are demonstrating to their constituents that they are striving to meet these goals (U.S. EPA, 2004). In Hayward, California, the city has installed a 276 kW rooftop solar power system that produces enough electricity during the day to power nearly 300 homes. Over its 30-year life span, electricity from the system will result in avoided emissions of more than 2,000 tons of CO_2 (U.S. Mayors, 2007).

Multnomah County, Oregon – Largest Solar Power Installation in the Northwest

In 2007, the Multnomah County Board of Commissioners adopted a plan to develop a solar power system that will be installed across six county buildings and will produce approximately 1,000 kWh per year. The project will be funded with assistance from a $2.3 million grant from Energy Trust of Oregon. The remaining cost, which will be will be offset by 80% by federal and state tax credits, will be paid by a third-party financier that will sell the electricity to the county at current rates or lower. Once it has recouped its costs, the third party will transfer ownership to the county.

The project is expected to supply 2.5% of the county government's energy, which will reduce the county government's GHG emissions by nearly 700 tons per year, approximately 2%.

Source: Sulzberger, 2007; Multnomah County, 2005.

- *Increase economic benefits through job creation and market development.* Investing in on-site renewable energy generation can help stimulate local, state, and regional economies. On-site renewable energy generation systems require a considerable amount of raw materials, and purchasing these materials from local businesses can increase local manufacturing employment. Demand for construction, installation, and maintenance of on-site renewable energy generation systems can lead to significant job creation and market development for these technologies (U.S. EPA, 2004). Figure 7.2.1 illustrates employment benefits by sector.

Chicago – Recruiting Renewable Energy Industry

By committing to generate renewable energy on-site, local governments can entice renewable energy equipment industries to locate in their area, bringing manufacturing, construction, and installation jobs.

In 1999, Chicago, Illinois reached an agreement with a PV manufacturer that committed the city to purchasing at least 250 kW of equipment from the manufacturer to be installed at some of its government facilities at a cost of about $2 million. In return, the manufacturer agreed to locate a new manufacturing plant in the city, completed in 2002, that created nearly 100 jobs.

In 2003, the city signed an agreement with a second PV manufacturer to install $5 million in solar thermal systems at city facilities. The city also offered interest-free financing to the company for it to relocate to the city from another state. The company currently employs 15 full-time staff.

Source: LBNL, 2002; U.S. EPA 1999; Chicago, 2008.

- *Improved power quality and supply reliability.* Electricity is defined as having high power quality if delivery of the required amount of energy is consistently without variation. Sags or spikes in voltage may be evidence of poor power quality. The complex network of interconnections involved in generating, transmitting, and delivering grid-based electricity causes temporal variations in the characteristics of delivered power. Because on-site renewable energy generation systems have fewer interconnections (e.g., transmission substations), electricity from these sources is less likely than fossil fuel-based electricity from the grid to have power quality disruptions (U.S. EPA, 2004; MTC, 2002).

  In addition to power quality, local governments are concerned with energy supply reliability. Energy supply disruption is a serious risk for local governments, many of which own hospitals, schools, and other facilities that house residents who may rely on a consistent electricity supply. By installing renewable energy generation systems on-site, local governments can improve energy supply reliability and protect against grid-based electricity shortages or blackouts (U.S. EPA, 2004).

Figure 7.2.1 Job Creation from Renewable Energy Projects per MW Capacity

Power Source	Manufacturing* (jobs/MW)	Construction & Installation (jobs/MW)	Operation & Maintenance (jobs/MW)	Total Jobs/MW
Solar PV	15.2	7.1	0.1	22.4
Wind	3.5	2.6	0.3	6.4
Solar Thermal	N/A	5.7	0.2	> 5.9
Geothermal	4.8	4.0	1.7	10.5
Natural Gas**	N/A	1.0	0.1	> 1.1

* Includes component manufacturing.
** Natural Gas is not considered a renewable energy. It is included here for comparison.

Source: Apollo Alliance, 2007.

7.2.3 Energy Supply Measures and Technologies

Local governments can select from a range of technologies for on-site renewable energy generation. Renewable energy sources that can be captured using on-site systems include:

- *Wind.* Wind energy, which is captured on-site using wind turbines, can be very cost-effective in areas with adequate wind resources. A 3-kW turbine with a 60 to 80 foot tower could reduce a facility's monthly electricity bill by 30% to 60%, assuming monthly electricity costs range between $60 and $100

Hull, Massachusetts – Wind Power

In December 2001, Hull, Massachusetts, a coastal town on a peninsula south of Boston, purchased a 660 kW wind turbine to replace a pre-existing structure that had once served the town's high school. A second turbine, installed in May 2007, has a capacity nearly three times the first turbine. Combined, the two turbines generate enough electricity to supply 11% of Hull's load.

The electricity from the turbines is generated at a cost of 3.4¢ per kWh, which is less than half of the 8.0¢ it would cost from the grid.

Source: Hull, 2008.

(approximately 700 kWh to 1100 kWh).[2] Using the national average installed cost for wind projects in 2006 (approximately $1,480 per kW capacity), these cost savings could result in a payback period as short as six years (AWEA, 2007b; U.S. DOE, 2007c).

As opposed to large utility-scale wind farm turbines, which can reach capacities as high as 3 MW, "small wind" turbines (turbines that have capacities of 100 kW or less) are often better suited for local facilities (AWEA, 2007b).[3] Wind turbines are most often installed in non-urban areas because installations typically require at least one acre of land and wind speeds averaging 15 mph at 50 meters above the ground (U.S. EPA, 2004). However, small turbines can be appropriately sited in urban areas. Boston, Massachusetts, for example, plans to install a 1.8 kW wind turbine at its city hall in 2008 (Boston, 2008).

- *Solar*. Sunlight provides an abundant source of renewable energy. Solar energy can be captured using multiple technologies, including:
  - Photovoltaics (PV). PV systems directly convert sunlight into electricity using solar cells. These systems, which can produce electricity even in the absence of strong sunlight, can generate significant quantities of electricity depending on several factors, including quality of the sunlight and the system's mounted pitch. For instance, the San Diego Regional Energy Office estimates that PV systems in the San Diego area can produce between 1,400 kWh and 1,700 kWh per kW capacity annually (SDREO, 2007). The New York State Energy Research and Development Authority (NYSERDA) estimates that PV systems can produce between 1,000 kWh and 1,300 kWh per kW capacity annually in New York (NYSERDA, 2007). A 10-kW system that produces 1,500 kWh per kW capacity per year could thus produce 15,000 kWh annually. In a 20,000 square foot office building that uses 15.5 kWh per square foot,[4] this system could reduce grid-based electricity purchases by approximately 5%.

Tallahassee, Florida – Solar Initiatives

The city of Tallahassee, Florida has installed PV and solar water heating equipment at multiple city facilities. A 10 kW PV system has been installed at a public gymnasium and aquatic center to provide up to 14,000 kWh annually. In addition, the city has installed an 18 kW PV system at the Capital Center Office Complex and a solar hot water system at the City Hall. The solar hot water system captures heat from sunlight, concentrating it to heat water that is distributed throughout the facility.

In addition to installing renewable energy generation equipment at local government facilities, the city offers rebates of up to $450 for solar water heating system installations at residential or commercial facilities. The city also offers low-interest loans to further ameliorate the costs of installing the equipment.

Source: Tallahassee, 2007.

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[2] KWh approximations determined using most recent average retail price for conventional electricity (9¢ per kWh) (EIA, 2007).

[3] Most small wind turbines have capacities of less than 25 kW (AWEA, 2007b).

[4] The average annual energy consumption per square foot for an office building in the United States is approximately 15.5 kWh per square foot (U.S. EPA, 2007c).

PV systems are often installed on roof tops, making them ideal for local government buildings in areas where open space is limited. Local governments have installed PV systems at a wide range of building types, including fire stations (Minneapolis, Minnesota) and libraries (Duluth, Minnesota) (Minneapolis, 2007; Duluth, 2002). PV systems can also be installed as stand-alone systems (i.e., systems that are not connected to the electricity grid) on parking meters (Portland, Oregon), bus stop canopies (Phoenix, Arizona), and on parking lot lights (Anaheim, California) (Portland, 2007; Phoenix, 2007; Anaheim, 2001).

- Solar Hot Water. Passive solar hot water technology uses sunlight to heat water in a collector and then distribute the heated water throughout a building, reducing a building's reliance on a conventional hot water heater that uses non-renewable sources of energy (NREL, 2007c).
- Solar Process Heating and Cooling. Solar process heating uses sunlight to provide space heating in buildings. This technology captures heat from sunlight using contained air or fluid as the medium. The captured heat is then fanned or pumped to distribute it throughout the building. The heat from a solar collector can also be used to cool a building in the same way that electricity is used to power air conditioning units (NREL, 2007a).

- *Geothermal.* Geothermal systems capture the earth's heat for use in generating electricity and providing heating and hot water. In direct use applications, steam from beneath the earth's surface can be used to power turbines to produce electricity. This type of geothermal application is dependent on the availability of adequate geothermal reservoirs (reservoirs of water with temperatures between 68^{o} F and 302^{o} F), which are more common in the western United States.

  A second type of geothermal technology uses heat pumps to capture the earth's natural heat to warm liquid that is pumped into buildings from underground piping to provide central heating or to heat water. In warmer seasons, geothermal heat pumps can exchange warm surface air for cooler below-ground air (U.S. DOE, 2006a). Geothermal heat pump systems are typically installed at shallow depths (e.g., 4 feet to 6 feet below the surface). Because shallow ground temperatures are fairly constant throughout the United States, geothermal heat pumps can be effective in most locations (U.S. DOE, 2007d).

- *Biomass.* Electricity-producing steam turbines can be fueled by burning solid biomass feedstocks,

North Bonneville, Washington – Geothermal Heat Pumps

North Bonneville, a community of 500 people, has installed a geothermal energy system in its City Hall. The system includes two 5-ton geothermal heat pumps, which provide heating and cooling for the 4,600 square foot building. The system, which cost about $16,700, reduces grid-based electricity use by about 34,000 kWh annually compared to the replaced electrical system, resulting in energy cost savings of approximately $1,500 annually. The city used a grant from the state energy office to offset 25% of the total cost of the system.

Source: GeoExchange, 1997.

City Captures Methane at Municipal Water Reclamation Facility

The Truckee Meadows Water Reclamation Facility is jointly owned by the cities of Reno and Sparks, Nevada and operated by the city of Sparks. In addition to treating wastewater for reuse, the facility captures methane produced in the treatment process. The methane is used to fuel a 700 kW generator, which produces electricity that is sold to the local utility. In February 2007, Sparks received $287,000 from the utility in compensation for three years worth of electricity contributions to the grid.

Source: Green Jobs, 2007.

such as plant material, construction wood, agricultural wastes, sewage and manure. Biomass can be used to generate electricity by heating feedstocks in an oxygen-free environment to convert them into combustible oil or gas biofuels. This gasification process can be up to two times more efficient than burning solid biomass, and results in reduced GHG emissions. By siting biomass operations in areas that have abundant biomass resources, such as agricultural or forestry waste, local governments can take advantage of material that would otherwise be wasted (U.S. EPA, 2000; 2004). Battle Creek, Michigan has entered an energy performance contract to install a boiler that will be fueled by burning 22 tons of wood chips from recycled shipping pallets each year and will provide 90% of the city hall's heating load (Battle Creek, 2007).

- *Landfill Gas and Other Biogas.* Equipping landfills and other facilities (e.g., wastewater and manure treatment facilities) to capture biogas provides a source of renewable energy from a byproduct that would otherwise be wasted. Biogas contains methane, a natural by-product of anaerobic digestion of landfill refuse, sewage, and other products, which can be converted into electricity through conventional combustion processes. For example, a single landfill gas recovery project can reach capacities as high as 4 MW (U.S. EPA, 2004).

  Methane is a potent GHG that has a global warming potential 21 times that of CO_2, and landfills are responsible for 34% of the nation's methane emissions (U.S. EPA, 2008b). Landfill gas and other biogas recovery projects can therefore provide a significant contribution to reducing the risks of climate change. In addition, these projects can produce other environmental benefits, including reduced waste odors and pathogens, as well as economic benefits (U.S. EPA, 2006b). A 3 MW landfill gas project, for example, can support more than 70 full-time jobs over the course of a year (U.S. EPA, Undated). For more information on landfill gas projects, see Section 7.4, *Landfill Methane Utilization*.

Cayuga County, New York – Biogas from an Anaerobic Digester

The Cayuga County Soil and Water Conservation District is planning a facility that will use untreated manure from local farms to fuel an anaerobic digester. The digester will produce biogas, which will be combusted to achieve up to 625 kW of electricity generation capacity for county buildings. The by-product from the digesters is returned to the local farmers in the form of a liquid fertilizer with a reduced phosphorus content, and has a smaller pollution potential than raw, untreated manure.

Manure management efforts can also have significant GHG emission reduction benefits. Manure is a source of methane emissions, a GHG with 21-times the global warming potential of CO_2. According to one study, manure capture and utilization for biogas can reduce methane emissions from manure biodegradation by three tons per cow per year (in terms of CO_2 equivalency). In addition, using manure biogas to produce electricity can offset one ton of CO_2 emissions per cow per year, by replacing grid-based electricity generated from conventional fuel sources.

Source: Cayuga County, 2007; U.S. EPA, 2004b.

- *Municipal Solid Waste.* Municipal solid waste (MSW) that would otherwise be sent to landfills can be burned to produce steam to power electricity-generating turbines in a processed referred to as "waste-to-energy" (WTE). There are currently 89 operational WTE facilities in the United States, with a combined capacity of 2,500 MW (U.S. EPA,

Tampa, Florida – Waste-to-Energy Facility

Twelve waste-to-energy facilities in Florida combine to achieve a capacity of more than 500 MW, eliminating 90% of the state's municipal solid waste. The Tampa waste-to-energy facility, for example, allows the city to take advantage of an available renewable energy resource and to use the revenues from electricity sales to offset the cost of waste disposal.

Source: Tampa, 2007.

2007c). While burning MSW can produce energy and reduce waste streams, it is important to note that WTE projects can also produce emissions of NO_x, SO_2, and CO_2 and trace amounts of toxic pollutants (e.g., mercury compounds and dioxins) if not rigorously monitored (U.S. EPA, 2006c). WTE projects are currently not eligible sources of green power under EPA's Green Power Partnership (U.S. EPA, 2008c).

- *Low-Impact Hydropower*. Hydropower projects capture the kinetic energy of moving water to produce electricity. While hydropower is renewable and produces relatively few GHG emissions, hydropower projects can have other impacts on the environment, such as obstructing fish passage and altering land resources by impounding excessive nutrients (U.S. EPA, 2006a). The Low-Impact Hydropower Institute (LIHI) provides certification to hydropower projects that demonstrate minimal impact on the environment. The EPA Green Power Partnership only recognizes as green power hydroelectricity that is generated by LIHI-certified projects (LIHI, 2008).

- *Fuel Cells*. Fuel cells combine oxygen and hydrogen to produce electricity without combustion, resulting in fewer GHG emissions. However, fuel cells require a continuous stream of hydrogen-rich fuel and can only be considered a renewable energy technology if they operate on a renewably-generated hydrogen fuel, such as digester gas or pure hydrogen generated by solar or wind energy generating systems (U.S. EPA, 2004).

Seattle, Washington – Low-Impact Hydro Facility

Seattle City Light, the municipal electric utility in Seattle, Washington, owns and operates the Skagit Project on the Skagit River. This LIHI-certified hydroelectric facility has a capacity of 690 MW and generates 2.5 million MWh annually. When conferred certification in 2003, Skagit was the largest low-impact hydroelectric project in the U.S.

Source: LIHI, 2003.

Rialto, California – Wastewater Treatment Facility Fuel Cell

Rialto, California is installing a 900 kW fuel cell system at its municipal wastewater treatment facility. The facility is collecting used fats, oils, and grease from local restaurants that can be digested to produce methane. The fuel cell will use the methane to produce electricity. The city expects that the system will reduce electricity costs by $800,000 annually, and will result in the avoidance of nearly 5.5 million tons of CO_2 emissions. The $15 million project cost will be partially lowered by a $4 million rebate from the state, resulting in a payback period of approximately 14 years.

Source: Chevron, 2007.

7.2.4 Key Participants

A number of participants are key to planning and implementing on-site renewable energy generation projects at local government facilities and throughout the community, including:

- *Mayor or County Executive*. The mayor or county executive can play a key role in increasing public awareness of the benefits of on-site renewable energy generation. Including on-site renewable energy generation in the mayor or county executive's priorities can lead to increased funding for renewable energy projects and broader implementation throughout the local government and the community. The mayor of Newton, Massachusetts created the Mayor's Advisory Committee on Renewable Resources to facilitate PV system installations at the local high school, a community center, and in several residences (Newton, 2005).

- *City and County Councils*. Renewable energy generation activities are often initiated by the city and county council. In Albuquerque, New Mexico, for example, the city council passed a resolution that established a City Renewable Energy Initiative, which includes a requirement to retrofit all existing city-owned facilities with renewable energy generation systems. In addition, all new facilities over 100,000 square feet are to be equipped with renewable energy generation systems capable of producing enough energy to meet at least 25% of the facility's energy requirements (Albuquerque, 2005).

> **San Francisco – Mayor's Solar Initiative**
>
> In February 2007, the mayor of San Francisco announced an initiative to increase the city's solar power capacity from 2 MW to 35 MW. The mayor's plan encourages private and public entities to partner with the San Francisco Public Utilities Commission (PUC) to achieve this goal. In September 2007, as part of this initiative, the mayor unveiled a new PV system at the city's airport, a joint project between the airport and the PUC. The new system, which will generate 628,000 kWh of electricity annually, will help move the city toward the mayor's goal of achieving 35 MW solar capacity. In addition, the project is expected to reduce CO_2 emissions by 7,200 tons over the next 30 years.
>
> Source: San Francisco, 2007a; 2007b.

- *Planning Departments.* Many local governments have modified local ordinances to facilitate on-site renewable energy generation system installation. These modifications often require coordination with local planning staff. After multiple proposed wind energy generation projects had been rejected for not conforming with the existing ordinance, the city council of Fitchburg, Massachusetts asked the city's planning department to develop legislation to modify the ordinance to include specifications for wind projects. In February 2008, the planning department presented the city council with proposed legislation that was approved following a public hearing (Butler, 2008).

- *School Districts*. Many local governments have worked with school districts to install renewable energy generation systems at K-12 schools. The Portsmouth, Rhode Island Sustainable Energy Subcommittee, for example, is working with staff and administrators from local schools to perform feasibility assessments for installing wind turbines at school premises (Portsmouth, 2007). School boards sometimes lead initiatives to install renewable energy generation systems at district facilities. In June 2007, the Berkeley, California School Board passed a resolution authorizing use of funds to complete a PV project at one of the school district's facilities (BUSD, 2007).

> **Bayonne, New Jersey School District – PV Installation**
>
> In cooperation with the New Jersey Board of Public Utilities, the Bayonne Board of Education committed to installing nearly 10,000 solar panels at the local high school and eight elementary schools. These panels will have a combined capacity of approximately 2 MW of energy, and produce enough to power 200 small homes for 30 years.
>
> The state's Clean Energy Program provided $5.4 million worth of solar equipment and installation credits for the $13.2 million project. In addition to reducing reliance on fossil fuels, reducing pollution, and decreasing the local strain on the electric grid, the project is expected to save the school district more than $500,000 in avoided annual electricity costs.
>
> Source: New Jersey, 2006

Installing renewable energy generation systems at schools can produce significant energy cost savings while also serving as an educational tool for demonstrating the benefits of renewable energy generation to students and the community at large. When the Lake Washington School District installed a 1 kW PV system at Redmond High School in King County, Washington, the district installed an information kiosk in the main hallway to provide students with an understanding of their school's energy use and solar power's contribution in real-time (Lake Washington School District, 2006). In Shoreline, Washington, the PV-equipped Meridian Park Elementary School has been used as an educational demonstration site and has hosted solar power fairs (Seattle Green Power, 2007).

- *Utilities*. Many utilities offer technical and financial assistance for on-site renewable energy generation system installation and operation. A number of local governments work with utilities to help local businesses and residents take advantage of these opportunities. In Sacramento County, for example, six city councils have waived permitting fees for PV installations at the behest of the local municipal utility, which is providing additional incentives of as much as 25% of the PV system costs (SMUD, 2007b).

  Many local governments have worked with municipal electric utilities to adopt and implement net metering and renewable portfolio standard rules. The municipal electric utility in Tallahassee, Florida offers net metering for commercial and residential PV systems up to 10 kW in capacity (Tallahassee, 2007). In March 2007, the city of New Orleans adopted net metering rules for utilities under its jurisdiction that mirrored the statewide net metering rules established in 2005 by the state Public Service Commission (DSIRE, 2007g).

Net Metering

Net metering rules have been established in 42 states and Washington, D.C. These rules require utilities to allow customers to use excess energy generated on-site to offset their consumption of energy from the grid. Where net metering rules are in place, affected utilities are required to measure the flow of electricity both to and from the customer. Customers pay for interconnection costs, but receive credit toward the following month's bill for net excess generation, typically at the utility's retail rate but sometimes at the lower, wholesale rate, depending on state net metering rules.

Absence or presence of net metering rules can be an important consideration for local governments when planning on-site renewable energy generation systems. If there is a chance that a local government renewable energy generation system will produce more electricity than required, connection to the grid and net metering rules can ensure that the excess electricity is rewarded.

- *Non-Profit Organizations*. Local governments can obtain technical and financial assistance from non-profit organizations to purchase and install on-site renewable energy generation systems. Ashland, Oregon, for example, received a grant from a non-profit organization to establish the Ashland Solar Pioneer Program. Through this program, solar PV systems were installed at four locations throughout the city, including two city-owned buildings. Excess energy generated from the PV systems is sold by the Ashland municipal utility to local customers (Ashland, 2007).

- *Energy Service Companies (ESCOs).* Many local governments have partnered with ESCOs to install renewable energy generation equipment on-site at no up-front cost. Using performance contracting agreements, local governments can pay for installed equipment over time using energy cost savings. Cathedral City, California, for example, partnered with an ESCO to install a $2.7 million PV system canopy at a city-owned parking garage. The PV system was installed at no up-front cost to the local government and is to be paid for using energy cost savings, which are expected to reach $180,000 annually (Honeywell, 2007).

- *Developers and Financiers.* A number of local governments have purchased and installed PV systems through developers and financiers in an arrangement called the "solar services model" that partners local governments with developers who secure financing from a third party and install PV systems at local government facilities. The San Diego Unified School District has used this financing model to install more than 10,000 MW of PV panels across 20 school facilities (San Diego, 2007d). (For more information on the solar services model, see Section 7.2.7 on page 17).

7.2.5 Mechanisms for Implementation

Local governments have used several mechanisms to initiate on-site renewable energy generation projects at their facilities and to adopt incentives for local businesses and residents, including:

- *City or County Council Resolutions.* In some local governments, city and county councils must approve major alterations to government buildings and significant expenditures that require financing. In Hayward, California a city council resolution authorized spending $900,000 to install a solar power generating system at one of its facilities (Hayward, 2005). In Ann Arbor, Michigan, the city council passed a resolution setting a goal for 5,000 solar hot water and PV systems to be installed across the city by 2015 (Ann Arbor, 2008).

- *Building Energy Codes.* Many local governments have adopted building energy codes, some of which include requirements that new buildings be designed to maximize potential for on-site renewable energy generation. In Marin County, California, for example, the local building energy code requires new subdivisions to be designed to accommodate for passive solar heating and cooling. Under the code, streets, lots, and building setbacks are to be arranged so that buildings are oriented with the long axis running east-west to maximize sunlight on the rooftop (Marin, 2008).

- *Net Metering Rules.* In states that do not have statewide net metering rules, or in states where net metering rules apply only to investor-owned utilities, local governments may be able to establish their own net metering rules for their own municipal utilities. For example, the city council of Yellow Springs, Ohio passed an ordinance requiring the municipal utility to provide net metering for customers, since the state's net metering rules apply only to investor-owned utilities (DSIRE, 2007d).

- *Renewable Portfolio Standards.* Many states have established renewable portfolio standards for investor-owned utilities. These rules require utilities to meet a certain percentage of their energy supply with energy from qualified renewable sources. Some local governments have adopted similar requirements for municipal utilities. In 2007, the city council of Austin, Texas passed a resolution that requires the municipal utility to use 30% renewable energy. The resolution requires that 100 MW of solar PV be used to generate the electricity to meet the 30% mandate (Austin, 2007).

- *Zoning Ordinance*. Some local governments have found that modifications to zoning ordinances can facilitate renewable energy generation projects. For example, some zoning ordinances prohibit erection of structures that are in excess of 35 feet, a restriction that precludes installation of most wind turbines and some solar panels (U.S. DOE, 2005). A market survey of the "small wind" manufacturing industry identified restrictive zoning and permitting rules as the second most significant barrier to market expansion (after cost premiums) (Stimmel, 2007).

A number of local governments have adopted ordinances with specifications for wind turbines that have clarified and streamlined the local permitting process. Rockingham County, Virginia approved a zoning ordinance in 2004 that established specifications for permitting the installation of small wind turbines, including maximum turbine height, minimum parcel size, minimum setbacks, and noise limits (DSIRE, 2007c). Mason City, Iowa amended its existing zoning ordinance to allow for wind turbines to be installed in any zoning district (rather than in commercial or industrial zones exclusively) and to establish rules for siting turbines of 100 kW or greater (Mason City, 2006).

Model Ordinances for Wind Turbines

A number of state governments, such as Massachusetts, have developed model zoning ordinances to facilitate local government siting of wind turbines. In other states, local governments have worked together to develop model zoning ordinances. In Minnesota, for example, several counties combined efforts with a non-profit organization and a regional development corporation to produce a *Model Wind Ordinance* and *Companion Document* in 2006.

Sources: MDER, 2007; MN Project, 2007.

California Law Requires Local Governments to Permit Certain Wind Energy Projects

In 2001, California passed legislation that prohibits local ordinances that unnecessarily impede the permitting of small wind projects. The legislation prohibits local governments from adopting ordinances that are more restrictive than the standards set forth in the legislation. The law effectively requires local governments to permit projects that meet these standards.

Source: California Assembly, 2001.

- *Ballot Initiatives.* In some communities, constituent approval may be necessary to obtain funds for on-site renewable energy generation projects. In 2001, San Francisco voters approved a ballot proposition for a solar revenue bond of $100 million to pay for the installation of solar panels, wind turbines, and energy efficiency technologies at city facilities (DSIRE, 2007e). In Columbia, Missouri, voter approval was required to establish a local renewable portfolio standard for the city’s municipal utility (2% by 2008, increasing to 15% in 2023) (DSIRE, 2007f).

- *Incentives for On-site Renewable Energy Generation.* Many local governments have established incentives for commercial and residential renewable energy generation projects. These incentives have included:

  - *Rebates.* Local governments have established financial incentives for residents and businesses to install renewable energy generation equipment. The Sacramento Municipal Utility District offers customers a rebate of $2.50 for every watt of solar energy generating capacity installed. The utility estimates that with the rebate, the simple payback period ranges between 8 and 15 years (SMUD, 2007).

Lakeland, Florida Free Solar Installations

The municipal utility in Lakeland, Florida offers free installation of solar water heating systems in local homes. Residents pay only for water used, which is provided at a solar energy rate that is lower than the local electricity rate. The municipal utility benefits from reduced peak energy demand and from the sale of the RECs associated with the production of the renewable energy.

Source: DSIRE, 2007.

- *Expedited Permitting.* A number of local governments are facilitating commercial and residential on-site renewable energy projects for residents by expediting permitting processes. Pike County, Illinois, for example, has approved an ordinance that establishes specific criteria for wind energy projects. Providing developers with an explicit list of criteria for approval will help reduce the cost of designing on-site renewable energy generation systems (DSIRE, 2007a).

Berkeley, California Sustainable Energy Financing District

In November 2007, the Berkeley City Council approved a framework for a voluntary program that would enable property owners to install photovoltaic systems by paying for the costs in assessments on their property tax bills over 20 years. The city would provide the initial funding for the installations through a taxable bond. A pilot program will be launched in Summer 2008.

In its 2008 *Sustainable Energy Plan*, Boulder, Colorado adopted a strategy of tracking the Berkeley pilot project's progress and investigating opportunities to establish a comparable sustainable energy financing district in Boulder.

Source: Berkeley, 2007; Boulder, 2008.

- *Permit Credits and Waivers*. A number of local governments have adopted permit credits or permit fee waivers to reduce the cost of installing on-site renewable energy generation systems. In Tucson, Arizona, for example, a city council resolution directed the Department of Development Services to offer building permit credits of up to $1,000 to applicants who install new PV, solar hot water and space heating, or solar air conditioning systems capable of producing a minimum of 1,500 kWh annually (Tucson, 2005). In 2007, the Board of Supervisors of San Bernardino County, California waived permit fees for installations of solar or wind power generation systems, solar hot water heaters, and energy-efficient heating and cooling systems on rooftops throughout the county. The fees for these permits had ranged from around $80 for water heaters to nearly $250 for wind turbines (U.S. DOE, 2007d; Gang, 2007).

- *Property tax credits and exemptions.* Some local governments have passed resolutions that modify local tax codes to provide incentives for local businesses and residents to install on-site renewable energy generation systems. In Howard County, Maryland, for example, the city council passed a resolution modifying the local tax code to offer property tax credits for residential facilities that use PV systems or geothermal heat pumps. The credit is equal to the lesser of 50% of the installed cost or $5,000 for a heating or electricity generation system ($1,500 for a hot water supply system) (Howard County, 2006). Harford County, Maryland has a similar tax credit program that offers a tax credit equal to the lesser value of one year of property taxes or $1,000 for residential and commercial facilities that use solar power for heating or cooling (DSIRE, 2007i).

7.2.6 Implementation Considerations

Local governments have used a number of approaches to enhance the effectiveness of on-site renewable energy generation at their own facilities and throughout the community, including:

- *Bundle on-site renewable energy generation with energy efficiency improvements*. Combining renewable energy generation with energy efficiency improvements that reduce energy loads enables local governments to meet a greater percentage of their electricity with electricity from renewable sources. In addition, the energy cost savings produced by energy efficiency improvements can be used to offset the purchase and installation costs of renewable energy generation systems and thus shorten payback periods.

- *Combine on-site renewable energy generation with green power purchases.* Local governments can achieve increased GHG emissions reductions by combining on-site renewable energy generation with green power purchases. Santa Monica, California, for example, has installed PV systems at multiple city facilities and is purchasing solar energy from an energy service provider to meet the balance of its energy needs (U.S. EPA, 2004; Santa Monica, 2007).

Tucson, Arizona –On-site Renewable Energy Generation and Energy Efficiency

In 1998, Tucson, Arizona incorporated renewable energy generation into its overall energy-efficiency strategy for the new Southeast Service Center. The building was designed in accordance with the recently adopted local Sustainable Energy Standard, a building energy code 50% more energy-efficient than the model energy code of that time. In addition to using high efficiency HVAC system components and energy-efficient insulation and lighting, the building draws energy from a 5 kW PV array installed on its roof.

Combined, the energy efficiency and renewable energy measures save the building $3,100 in annual energy costs. The building's average energy cost per square foot ($1.17) is significantly lower than the average energy cost per square foot in comparable city buildings ($2.00 to $2.40).

Source: Hoff, 2000; SWEEP, 2008.

- *Coordinate with neighboring local governments.* By coordinating with other communities, local governments can achieve greater regional energy, environmental, and economic benefits. Encouraging on-site renewable energy generation throughout a region can lead to increased regional employment, reduced risk of energy supply disruption, and lower up-front costs due to market and technology maturation. In Arizona, the Maricopa Association of Governments, representing a collection of communities around Phoenix, issued regional standard procedures for permitting PV system installations. The standards have since been adopted by cities outside the association (Maricopa Association of Governments, 2002). The Alaska Village Electric Cooperative, a member-owned utility cooperative that serves 53 villages in Alaska, has helped its member villages reduce their dependence on expensive fossil fuels by installing nearly 1,000 kW of wind power generating capacity. In two communities, renewable energy is now accounting for more than 25% of annual needs (U.S. DOE, 2008).

- *Engage the public.* Engaging businesses and residents in local government decision making can lead to enhanced support for on-site renewable energy generation projects. This support can be especially important given the significant local tax dollar investments many of these projects require. The Portsmouth, Rhode Island Sustainable Energy Subcommittee, for example, conducted multiple public workshops to inform local residents and businesses of the town's efforts to construct wind turbines at two local schools. These workshops provided town staff the opportunity to address community questions and concerns (Portsmouth, 2007).

- *Evaluate energy generation capacity*. Because some renewable energy generation technologies have higher generation capacities in certain regions (e.g., wind power and solar PV), many local governments have conducted thorough evaluations of renewable energy generation potential for their facilities. In Boston, Massachusetts, for example, the city has used GIS mapping to identify the best opportunities for PV system installations. This effort has enabled the city to estimate potential capacity for PV power at between 670 MW and 900 MW, which could provide for 14% to 19% of city-wide electricity (IREC, 2008).

- *Sell Renewable Energy Certificates (RECs).* RECs refer to the technological and environmental attributes associated with the generation of renewable energy. These attributes can be separated from the renewable energy, allowing renewable energy generators to sell RECs on the market as a distinct product. The separated electricity, without its attributes, is then environmentally equivalent to conventional (i.e., non-renewable) electricity. RECs can be bought by organizations that do not have direct grid access to utility-provided green power, or do not have access to enough utility-provided green power to meet organizational goals (U.S. EPA, 2006).

  Local governments do not typically sell the energy they generate. However, local governments can take advantage of the market for RECs by selling the environmental attributes associated with the renewable energy they generate. Hayward, California, for example, issued a city council resolution that authorizes the sale of RECs associated with an on-site solar energy city project for $93,000 (Hayward, 2005). Local governments that sell their RECs can still benefit from stable, predicable electricity costs, but environmental claims are no longer valid. Because of the wide range of prices for RECs on the market, some local governments have been able to sell RECs from the electricity they generate while maintaining environmental claims by using revenues from REC sales to purchase lower-price RECs. Remaining revenues can be used to offset purchase and installation costs for renewable energy generation systems or to invest in other clean energy activities. Alternatively, local governments could sell RECs only for a period of time (e.g., until generation system purchase costs are recovered) and then retain the RECs to achieve the environmental and technological attributes (NREL, 2007d). (For more information on RECs, see Section 7.1, *Green Power Procurement*).

7.2.7 Costs and Funding Opportunities

This section provides information on the costs associated with on-site renewable energy generation as well as information on how local governments can use multiple funding opportunities to address these costs.

Austin, Texas – City Installs Fuel Cell at Health Center

Austin Energy, the municipal utility of Austin, Texas, installed a 200 kW fuel cell at a local health center. The estimated cost of purchasing and installing the fuel cell was approximately $6,000 per kW, for a total of $1.2 million.

Source: Austin Energy, 2002.

<u>Costs</u>

Despite annual trends of declining costs, the cost premium associated with renewable energy generation systems can be significant (U.S. EPA, 2006b). Table 7.2.1, *Comparison of On-site Renewable Energy Technology Costs* provides rule-of-thumb approximations for costs associated with five renewable energy generation technologies and provides comparisons with the costs of other distributed generation systems that use conventional energy sources.

Table 7.2.1 Comparison of On-site Energy Generation Technology Costs

	Renewable					Conventional	
	Wind Turbine	**Solar PV**	**Geothermal**	**Fuel Cell**	**Biomass**	**Micro-turbine**	**Reciprocating Engine**
Typical Project Size	5 kW - 100 kW	10 kW - 100 kW	2 tons - 10 tons[o]	200 kW	5 MW - 50 MW	25 kW - 100 kW	5 kW - 7 MW
Typical Total Installed Cost	$1,000 - $5,000 per kW capacity[a]	$6,000 - $10,000 per kW capacity[b]	$2,500 per ton capacity[c]	$3,000 - $4,000 per kW capacity[d]	$1,500 - 2,500 per kW capacity[e]	$700 to $1,100 per kW capacity[f]	$1,075 per kW capacity[g]
Annual Operations and Maintenance Costs	$0.008 per kWh generated[n]	Minimal[j]	$0.015 - $0.045 per kWh generated[k]	$0.005 - $0.010 per kW capacity[d]	$0.0029 per kWh generated[l]	$0.005 - $0.016 per kW capacity[f]	$0.005 - $0.015 per kW capacity[g]
Life span	30 years	30 years	30 years - 45 years[k]	5 years - 10 years[m]	30 years[l]	45,000 hours (~ 5 years)[i]	20 years - 25 years

[a] U.S. DOE, 2005.
[b] CEC, 2007a.
[c] U.S. DOE, 2007b.
[d] WBDG, 2007.
[e] U.S. EPA, 2006.
[f] CEC, 2007c.
[g] CEC, 2007d.
[h] U.S. DOE, 2007c.
[i] U.S. DOE, 2003.
[j] PV Sustain, Undated.
[k] REPP-CREST, Undated.
[l] EIA, 2003.
[m] WBDG, 2007.
[n] U.S. DOE, 2007c.
[o] Geothermal unit capacity is measured in tons. One ton is equal to 12,000 Btu of energy per hour.

The installed cost of on-site renewable energy generation systems can be influenced by a range of factors, including the quality of the renewable resource in a given area, proximity of equipment manufacturers, and whether the installation was coupled with energy efficiency upgrades. While costs remain significant, they are decreasing. For example, according to a study by DOE, the cost of purchasing and installing small wind turbines has decreased from approximately $3,500 per kW in 1985 to less than $1,300 per kW in 2005 (U.S. DOE, 2007c). In addition, payback periods for on-site renewable energy generation systems are likely to continue to decrease electricity costs continue to rise. Availability of federal, state, local, and utility tax credits and rebates can also substantially reduce the payback period for these systems.

Funding Opportunities

Funding for local on-site renewable energy generation projects can come from a variety of sources, including:

- *Lease-Purchase Agreements.* A tax-exempt lease-purchase agreement (also known as a municipal lease) allows public entities to finance purchases and installation over long-term periods using operating budget dollars rather than capital budget dollars. Lease-purchase agreements typically include "non-appropriation" language that limits obligations to the current operating budget period. If a local government decides not to appropriate funds for any year throughout the term, the equipment is returned to the lessor and the agreement is terminated. Because of this non-appropriation language, lease-purchase agreements typically do not constitute debt.

Under this type of agreement, a local government makes monthly payments to a lessor (often a financial institution) and assumes ownership of the equipment at the end of the lease term, which commonly extends no further than the expected life of the equipment. These payments, which are often less than or equal to the anticipated savings produced by the energy efficiency improvements, include added interest. The interest rates that a local government pays under these agreements are typically lower than the rates under a common lease agreement because a public entity's payments on interest are exempt from federal income tax, meaning the lessor can offer reduced rates (U.S. EPA, 2004b). In Hayward, California, a city council resolution authorized the city to install a solar power generating system at a local government facility using a 25-year lease purchase agreement. This agreement enabled the city to install the system at an annual lease payment of $70,400 (Hayward, 2005).

Unlike bonds, initiating a tax-exempt lease-purchase agreement does not require voter referendum to approve debt, a process that can delay renewable energy generation system installations. Tax-exempt lease-purchase agreements typically require only internal approval and an attorney's letter, a process that often takes only one week (as opposed to months or years for bonds). Local governments can expedite the process by adding renewable energy generation projects to existing master lease-purchase agreements (U.S. EPA, 2004b).

- *Performance Contracting.* An energy performance contract is an arrangement with an ESCO that bundles together various elements of an energy-efficiency investment, such as installation, maintenance, and monitoring of energy-efficient equipment. These contracts, which often include a performance guarantee to ensure the investment's success, are typically financed with money saved through reduced utility costs but may also be financed using tax-exempt lease-purchase agreements (U.S. EPA, 2003c). Tucson, Arizona used a performance contract to install solar pool heaters and domestic hot water heating systems at five public swimming pools at no up-front cost. The city is paying for the systems using the energy cost savings they produce (Apollo Alliance, 2006; U.S. Conference of Mayors, 2007).

Duluth, Minnesota – Performance Contracting

In 2002, the city of Duluth, Minnesota partnered with an ESCO, agreeing to a 10-year performance contract that involved upgrades to the city's main library. In addition to other energy cost saving improvements to the facility, the ESCO installed a 2.4 kW PV system, along with an interactive kiosk to display the real-time energy produced and GHGs avoided as a result of the PV system. The cost of the project ($27,000 for the PV arrays plus $22,500 for the kiosk) will be paid using energy cost savings.

Source: Duluth, 2002.

Tax-exempt lease-purchase agreements are sometimes used to underwrite energy performance contracts with ESCOs. While local governments can often obtain financing directly from an ESCO, many have found that the interest rates available through tax-exempt lease-purchase agreements are typically lower than the rates offered by an ESCO. Tax-exempt lease-purchase agreements can be especially effective when used to underwrite energy performance contracts that include guaranteed savings agreements, under which an ESCO agrees to reimburse any shortfalls in expected energy cost savings.

- *Solar Services Model.*[5] Local governments have found that they can finance solar PV system purchases and installations at no up-front cost using the solar services model. Under this model, the local government signs a long-term (often ten years) power purchase agreement with a developer and agrees to host a PV system at its facility. The developer pays for the design, construction, and installation of the system, often arranging for third-party financing through an investor. The investor, who provides the up-front capital and owns the project, receives returns from payments from the host through the developer. The host's payments are at a pre-determined fixed price and are assessed much like a monthly utility payment. The local government, as host, benefits from fixed-price payments, reduced peak energy costs, and reduced greenhouse gas emissions, all at no up-front cost.

  In addition, under the solar services model, the host is not responsible for performing or paying for maintenance on the system, which is arranged by the developer. Ownership of the system can be transferred to the host when the developer's or financier's costs are recovered. Local governments that have used this model to install renewable energy generation systems at their facilities include Bend, Oregon and San Diego, California (Sandia, 2007; WRI, 2007; Bend, 2007; San Diego, 2007e).

Local Governments Providing Information on Funding Opportunities for Residential and Commercial Projects

In addition to offering local government or municipal utility financial incentives to residents and businesses, a number of local governments, such as Berkeley, California and Austin, Texas, assist residents and businesses by providing information on funding opportunities available through federal, state, NGO, and other programs.

Berkeley maintains a Web site advising local residents and businesses of available federal tax credits and rebates. Austin maintains a list of rebates and loans available through the local municipal utility and the Water Conservation Division for energy efficiency and renewable energy investments.

Sources: Berkeley, 2007b; Austin Energy, 2007.

- *Local Bonds.* A number of local governments have used bonds to finance renewable energy generation projects. In 2004, the city council of Honolulu, Hawaii passed a $7.85 million bond measure to fund the purchase and installation of PV panels for public buildings. This investment was coupled with lighting and heating, ventilation, and air conditioning energy efficiency upgrades to improve the overall cost-effectiveness of the renewable energy project (DSIRE, 2007h).

- *State Government*. Some states offer financial incentives to local governments that invest in on-site renewable energy generation. For example, NYSERDA provides cash incentives to local governments, colleges, and farms, to offset purchase and installation costs of small wind turbines. Local governments can be eligible for up to $144,000, depending on the turbine model and the tower height (NYSERDA, 2007). In Iowa, the state Department of Economic Development served as an intermediary for a $400,000 federal government

[5] The solar services model is occasionally referred to as an independent energy purchase (IEP).

community development block grant that was passed through to the city of Lenox to offset the cost of a 750 kW wind turbine in 2003 (Energy Services Bulletin, 2004). The California Energy Commission has compiled a list of private companies offering low-interest loans and mortgages for local governments, businesses, and residents who incorporate on-site renewable energy (CEC, 2007e).

Some states offer financial assistance for local government officials to receive training in on-site renewable energy generation technologies. Pennsylvania, for example, offered 50 scholarships in 2006 to local government officials so that they could attend a wind power conference (Pennsylvania, 2006).

- *Federal Government Sources.* Local governments can obtain financial assistance for purchasing and installing renewable energy generation systems from a variety of federal government sources. The U.S. Department of Energy (DOE), for example, provides grants and other financial incentives to local governments. Portland, Oregon received a $200,000 grant through DOE's Solar America Cities program to install solar PV systems at city facilities and to fund the city's *Solar Now!* Initiative, which installs solar PV systems at local residences (Ryan, 2007). Local governments and their residents and businesses can also find information on federal grants from 26 government agencies at http://www.grants.gov/.
- *Non-Profit Organizations.* Non-profit organizations, such as independent foundations, can be a source of funding for local government renewable energy initiatives. A number of investor-owned utilities have created independent foundations to support clean energy initiatives. The Illinois Clean Energy Community Foundation, for example, was established in 1999 by an investor-owned utility to invest in clean energy development and land preservation projects. Since awarding its first set of grants in 2001, the foundation has issued more than 2,600 grants totaling nearly $140 million. Many of these grants have been for local wind and solar projects. For example, a consortium of six counties in western Illinois received a $15,000 grant from the foundation to conduct a wind resource assessment study (ICECF, 2006; ICECF, 2008).
- *Utilities*. Local governments can sometimes obtain financial assistance from utilities, many of which offer incentives, such as rebates, for on-site renewable energy projects. Eugene, Oregon, for example, has received over $1.5 million in incentives from local utilities for energy efficiency and renewable energy projects, including the installation of solar water heating systems at multiple city-owned swimming pools (U.S. Conference of Mayors, 2006).
- *Voluntary Ratepayer Funding.* Some local governments have obtained funding for renewable energy generation projects from local residents. For example, Ellensburg, Washington used a unique financing approach that partnered local electricity customers with the city to install a 36 kW PV system. The city offered to reduce customers' future electricity bills in compensation for financial contributions toward the initial purchase and installation costs of the PV system. For example, if a customer were to contribute a certain percentage of the total funds contributed by all customers, that customer would receive that same percentage of the project's total solar power production, in the form of a deduction of their electricity bill (Ellensburg, 2007).

7.2.8 Interaction with Federal, State, or Other Programs

Local governments can obtain technical assistance and information from a number of federal, state, and other programs.

Federal Programs

- *U.S. EPA Clean Energy-Environment State and Local Program*. This program assists state and local governments in their clean energy efforts by providing technical assistance, analytical tools, and outreach support. It includes two programs:

  - The *Clean Energy-Environment Municipal Network* provides a resource network that supports local governments' efforts to use clean energy strategies to advance their community priorities.

  - The *Clean Energy-Environment State Program* supports state efforts to develop and implement cost-effective clean energy strategies that achieve public health and economic benefits. Through this partnership program, EPA provides technical assistance tailored to states' needs.

  A key resource for both Clean Energy-Environment programs is the *Clean Energy Resources Database*, which provides planning, policy, technical, analytical, and information resources for state and municipal governments.

  Web sites:
  http://www.epa.gov/cleanenergy/
  http://www.epa.gov/cleanenergy/energy-programs/napee/resources/database.html (Clean Energy Resources Database)
  http://www.epa.gov/cleanenergy/energy-and-you/affect/index.html (environmental impacts of renewable energy technologies)

- *U.S. EPA Green Power Partnership.* The EPA Green Power Partnership is a voluntary program to support the market for green power products. Local governments that meet

DOE Information Resources

The DOE Office of Energy Efficiency and Renewable Energy administers several programs that provide information and assistance for on-site renewable energy generation projects, including:

- *Wind and Hydropower Technologies Program*. Through this program, DOE works to improve wind energy technology development and deployment to help make wind energy competitive, and to develop new, cost-effective hydropower technologies that will have enhanced environmental performance and greater energy efficiencies. http://www1.eere.energy.gov/windandhydro/
- *Solar Energy Technologies Program*. Through this program, DOE partners state and local governments with national laboratories, universities, industry, and professional organizations to develop and deploy cost-effective technologies to expand the use of solar energy. http://www1.eere.energy.gov/solar/
- *Geothermal Technologies Program*. DOE administers this program in partnership with the geothermal industry to establish geothermal energy as an economically competitive contributor to the U.S. energy supply. http://www1.eere.energy.gov/geothermal/
- *Biomass Program*. DOE's Biomass Program provides information on biomass applications and potential, and existing state and federal biomass-related policies. http://www1.eere.energy.gov/biomass/
- *Hydrogen, Fuel Cells & Infrastructure Technologies Program*. Through this program, DOE works to develop hydrogen, fuel cell, and infrastructure technologies and to successfully introduce them in the mainstream market. http://www1.eere.energy.gov/hydrogenandfuelcells/

partnership requirements earn publicity and recognition and are ensured of the credibility of their green power purchases. In addition, partners can receive EPA expert advice on identifying green power products and purchasing strategies, and tools and resources to calculate the environmental benefits of green power purchases. The annual percentage requirements to qualify as a partner are as follows: 2% green power for entities using over 100 million kWh, 3% for between 10 million kWh and 100 million kWh, 6% for between 1 million kWh and 10 million kWh, and 10% for less than 1 million kWh.

Web site:
http://www.epa.gov/greenpower/

- *ENERGY STAR.* EPA's ENERGY STAR program provides a number of energy efficiency tools and resources that local governments can use when developing and implementing programs to reduce energy consumption. The ENERGY STAR Purchasing and Procurement program, for example, provides lists of energy-efficient products (including geothermal heat pumps) with performance specifications, product savings calculators for assessing the cost-effectiveness of purchasing these products, sample procurement language, product retailer locators, and case studies.

  Web sites:
  http://www.energystar.gov/
  http://www.energystar.gov/index.cfm?c = geo_heat.pr_geo_heat_pumps
  (ENERGY STAR-qualified geothermal heat pumps)

- *National Renewable Energy Laboratory (NREL).* NREL is the primary national laboratory for renewable energy and energy efficiency research and development. NREL provides local governments with information on existing and emerging technologies, including how to plan, site, and finance projects using renewable energy sources. NREL also provides information on developing rules and regulations for net metering and renewable portfolio standards for municipal utilities.

  Web site: http://www.nrel.gov/learning/re_basics.html

State Programs

Many local governments work with state agencies to obtain technical assistance and information on purchasing and installing on-site renewable energy generating systems. For example, the public benefits fund (PBF)-funded Massachusetts Technology Collaborative (MTC) administers the Community Wind Collaborative, through which it offers technical assistance, data analysis, and monitoring equipment to local governments that invest in wind energy projects. In addition, MTC offers rebates of up to $50,000 for public entities to offset the costs of designing and constructing solar, wind, or hydroelectric projects of up to 10 kW capacity (MTC, 2007). The Massachusetts Division of Energy Resources and Executive Office of Environmental Affairs have also developed a model zoning ordinance amendment that local governments can use to permit wind projects that minimize impacts on nature and public safety (MDER, 2007).

Some states assist local governments in developing siting guidelines for on-site renewable energy system installations. Michigan, for example, has developed guidelines for local governments to assist them in creating their own permitting requirements for wind energy projects. The guidelines include recommended zoning language for local governments to incorporate in ordinance modifications (Michigan DLEG, 2007).

Other Programs

- *Database of State Incentives for Renewables & Efficiency (DSIRE).* A project of the North Carolina Solar Center and the Interstate Renewable Energy Council, DSIRE provides information on federal, state, and local incentives for renewable energy and energy efficiency projects, including tax credits, loans, and grants. The database also provides information on state and local regulations pertaining to renewable energy purchases and on-site renewable energy generation, including overviews of state and local net metering rules, renewable portfolio standards, and requirements for renewable energy use at public facilities.

  Web site: http://www.dsireusa.org/

- *Interstate Renewable Energy Council (IREC).* IREC promotes deployment of renewable energy generation technologies at the state and local level by providing information and assistance to state and local governments for a number of renewable energy activities, including public education, procurement coordination, and adoption of uniform standards.

  Web site: http://www.irecusa.org/

- *American Council on Renewable Energy (ACORE).* ACORE, a non-profit organization comprised of members from renewable energy industries, trade associations, financial institutions, governments, end-users, and other affiliated non-profits, promotes activities that support renewable energy technologies. Through its Renewable Energy Finance Network, the organization provides information on funding sources for renewable energy and energy efficiency projects.

  Web site: http://www.acore.org/programs/refin.php

Industry Information Resources

A number of renewable energy technology membership organizations can provide information on the benefits and feasibility of on-site renewable energy generation. These organizations include:

- American Wind Energy Association (http://www.awea.org/)
- American Solar Energy Society (http://www.ases.org/)
- Geothermal Energy Association (http://www.geo-energy.org)
- Biomass Coordinating Council (http://www.acore.org/programs/bcc.php
- National Hydropower Association (http://www.hydro.org/)

7.2.9 Case Studies

The following case studies describe two comprehensive programs for generating renewable energy at local government facilities and reaching out to the community to involve local businesses and residents. Each case study describes how the program was initiated, key program features, and program benefits.

Boston, Massachusetts

Program Initiation

Boston joined the ICLEI Cities for Climate Protection initiative in 2000 and hired an energy manager in 2001. In 2005, the city's mayor signed the U.S. Mayors Climate Protection Agreement committing the city to meet Kyoto Protocol GHG emission reduction targets of 7% below 1990 levels by 2012, and 80% below 1990 levels by 2050. An executive order in 2007 reinforced this commitment, and required that all local government properties be evaluated for renewable energy generation potential. In 2007, the city also created the Boston Energy Alliance, a non-profit corporation to promote clean energy throughout the local government and the community. The city expects that the corporation's activities will involve participation of 25% to 35% of the city's electricity customers by 2013. Also in 2007, the city was named one of DOE's Solar America Cities, leading to the establishment of the Solar Boston initiative.

Profile: Boston, Massachusetts

Area: 90 square miles

Population: 590,000

Structure: Boston residents elect a mayor to a four-year term, and 13 council representatives to two-year terms each. The city's renewable energy activities, including the Solar Boston initiative, are directed by the Department of the Environment.

Program Scope: Boston has installed wind and PV energy systems at a broad range of facilities, including government buildings, public schools, and affordable housing units, and has worked with the private sector to encourage renewable energy generation at a number of businesses and residences.

Program Creation: The Solar Boston initiative was created following the city's selection as a DOE Solar America City in 2007. Previous activities, including participation in the ICLEI Cities for Climate Protection and the U.S. Mayors Climate Protection Agreement, contributed to the development of this initiative.

Program Results: By the end of 2008, the city expects to have a combined total of 1 MW solar PV capacity installed. Recent solar PV mapping efforts reveal that the city could meet 14% to 19% of its electricity supply using PV systems.

Program Features

- *Combining on-site renewable energy generation with green power purchases.* In addition to pursuing wind, solar, and biomass energy options, 11% of the electricity the city purchases comes from green power sources. This commitment will increase to 15% by 2012, as directed by a 2007 executive order (Boston, 2007).

- *Solar City.* Boston has been named as one of DOE's "solar cities." The Solar Cities Partnership is an initiative to establish model local governments that help improve national solar infrastructure and facilitate mainstream adoption of solar technologies (Boston, 2008b).

- *Solar Mapping.* As part of its activities under the Solar Boston initiative, Boston has used GIS technology to evaluate and map the potential for PV systems throughout the city. The mapping revealed a total potential capacity of between 670 MW and 900 MW on rooftops across the city. A similar effort is underway to evaluate the potential for solar water heating applications (IREC, 2008).

- *Affordable Housing.* The city is working with the Department of Neighborhood Development and the Boston Housing Authority to encourage installing solar PV equipment on affordable housing units. The Boston Housing Authority is investigating options for using a performance contract to install between 115 kW and 120 kW of PV capacity (Boston, 2008b).

- *Boston Energy Alliance.* This non-profit corporation was formed to facilitate the city's energy efficiency and renewable energy activities. The corporation will use a $300 to $500 million revolving loan fund to finance energy efficiency improvements and renewable energy generation systems at city facilities (Boston, 2008b).

- *Solar Workshop.* In January 2008, the city hosted a workshop to present its goals for the future of solar in the city, and to invite stakeholders to participate in city activities (Boston, 2008d).

- *Wind Power.* The city is working with the Massachusetts Technology Collaborative (MTC) to assess the feasibility of installing wind turbines on Long Island in the city's harbor. This study is being conducted in conjunction with a study by the state Water Resources Authority to install another turbine in the harbor. The city is also supporting an initiative by the Community Wind Collaborative to install small wind turbines throughout the city using $4 million in funds from the MTC Renewable Energy Trust. In addition, the city plans to install a 1.8 kW turbine at the city hall in 2008 and is in the process of developing a Wind Energy Zoning provision for the local zoning code that would streamline siting of wind turbines in the city (Boston, 2008; Boston, 2008c; Boston, 2008e).

Program Results

The city's initiative has resulted in solar PV installations on a broad range of buildings, including government buildings, housing developments, and public schools (Boston, 2007b). Under the Solar Boston initiative, the city expects to reach nearly 1 MW of total installed PV capacity in 2008 (1.8 MW if PV installations on affordable housing units is included) (Boston, 2008b). The solar PV mapping activities, which revealed a total capacity ranging between 670 MW and 900 MW, indicate that solar PV could supply between 14% and 19% of the entire city's electricity demand (IREC, 2008).

Web site: http://www.cityofboston.gov/climate/solar.asp

Waverly, Iowa – Waverly Light and Power

Waverly Light and Power, a municipal electric utility owned by the city of Waverly, Iowa was the first municipal utility in the country to generate its own wind power. The utility has set a goal of meeting 20% of its energy needs with renewable energy it generates by 2020.

Program Initiation

The utility's energy demand grew dramatically in the 1980s, leading city planners to consider alternative energy supplies. When the utility's purchased power contract terminated in 1991, it conducted a study to assess the feasibility of generating energy from renewable sources. In 1993, with grants from the American Public Power Association, Waverly Light and Power installed its first wind turbine (ICLEI, Undated; U.S. DOE, 2003).

Program Features

Profile: Waverly, Iowa

Area: 33 square miles

Population: 4,900 customers

Structure: Waverly Light and Power is a city-owned utility governed by the city-nominated Waverly Light and Power Board and a board-selected General Manager.

Program Scope: Waverly Light and Power's Green Choice and Energy Tags programs are available to the municipal utility's electric customers.

Program Creation: Waverly Light and Power installed its first wind turbine in 1993 in an effort to reduce the utility's rising energy costs.

Program Benefits: The utility is obtaining 5% electricity from renewable sources. This effort has resulted in CO_2 emission reductions as high as 7,000 tons in one year.

Source: ICLEI, Undated; Waverly, 2007.

To complement the first turbine purchased in 1993 (an 80 kW system) Waverly Light and Power purchased two additional 750 kW turbines in 1999. In 2002, the first turbine was replaced by a 900 kW turbine, which produces nearly 1.85 million kWh annually. In 2005, in order to purchase additional land on which new, state-of-the-art turbines could be built, the utility sold its two 750 kW turbines. With the addition of two new 900 kW turbines purchased in 2007, the utility will produce nearly 6 million kWh annually beginning in 2008.

The cost of the turbines has been financed in part by grants (from the American Public Power Association and from NREL) and in part from the utility's capital budget. The currently-active turbine cost just over $1 million installed. Maintenance costs typically reach approximately $1,500 per year per turbine. The utility offers its customers the opportunity to purchase some of this green power through its Green Choice program. Many local customers pay a premium of less than $2 per month to receive green power.

In addition to generating and selling renewable energy, Waverly Light and Power became the first U.S. utility to offer RECs in 2001. Under its Iowa Energy Tags Program, Waverly Light and Power sells the environmental attributes of the green power it produces to help pay for future investments in wind energy. Each tag represents 2,500 kWh of green power, which translates into a savings of more than two tons of CO_2 emissions (WLP, 2007a; WLP, 2007b; WLP, 2006; WLP, 2005; ICLEI, Undated; U.S. DOE, 2003).

Program Benefits

In 2002, Waverly Light and Power's wind turbines reduced the city's CO_2 emissions by nearly 7,000 tons. In 2005, the CO_2 emissions reduction was approximately 4,300 tons (following the sale of the two 750 kW turbines to raise money for investments in newer wind technologies). In addition, the sale of 800 energy tags earns the utility approximately $40,000 annually, money that is earmarked for investment in new renewable energy sources. Through 2003, Waverly Light and Power was meeting 5% of its energy demands from wind power (ICLEI, Undated; WLP 2006).

Web site: http://wlp.waverlyia.com/renewable_energy.asp

Resources

Table 7.2.2 On-site Renewable Energy Generation: Examples and Information Resources	
Title/Description	**Web Site**
Examples of On-site Renewable Energy Generation	
Albuquerque, New Mexico. Albuquerque has established a Renewable Energy Initiative that includes retrofitting existing public buildings with renewable energy generating systems. In addition, all new facilities over 100,000 square feet are required to meet 25% of their energy use with renewable energy.	http://www.cabq.gov/energy/documents/Resolution329.doc
Anaheim, California. The city has installed a stand-alone PV system to power parking lot lights at its municipal golf course. The PV system provides 576 watts of capacity.	http://www.anaheim.net/utilities/news/article.asp?id = 245
Ann Arbor, Michigan. The city council in Ann Arbor, a DOE-awarded Solar America City, has passed a resolution that sets a goal of having 5,000 PV systems installed throughout the city by 2015.	http://www.irecusa.org/index.php?id = 71&tx_ttnews[pS] = 1199894048&tx_ttnews[tt_news] = 866&tx_ttnews[backPid] = 70&cHash = 5be146144e
Ashland, Oregon. Ashland has established a Solar Pioneers Program that involved the installation of solar energy systems at city buildings. Energy produced by these systems is delivered to residents who fund the program by voluntarily contributing to the municipal utility's solar surcharge.	http://www.ashland.or.us/Page.asp?NavID = 1534
Austin, Texas. Austin, a DOE-awarded Solar America City, has established a renewable portfolio standard that requires the local municipal utility to deliver 30% renewable energy, which is required to be met, in part, by 100 MW of solar PV power.	http://www.ci.austin.tx.us/council/downloads/mw_acpp_points.pdf
Barrington, Rhode Island. The Barrington Town Council formed a committee of interested residents to perform a feasibility assessment for installing wind turbines on town-owned property.	http://www.ci.barrington.ri.us/government/wind-documents/town%20council%20presentation%20final%20june2007.pdf
Berkeley, California. Berkeley, California is installing a 1.8 kW wind turbine at its Shorebird Nature Center to produce electricity for saltwater aquariums, computers, and lighting. The turbine, which is specifically designed to generate electricity in low winds, will reduce the city building's annual GHG emissions by 80%.	http://www.ci.berkeley.ca.us/news/2007/06June/062007WindEnergyComestoBerkeley.html
Boise, Idaho. Boise has completed a geothermal loop that recycles geothermal water used to heat a number of city buildings.	http://www.eere.energy.gov/state_energy_program/project_brief_detail.cfm/pb_id = 1124
Boston, Massachusetts. In Boston, the mayor has announced plans to install a 1.8 kW wind turbine at its city hall in 2008.	http://boston.about.com/od/governmentcityservices/a/WindTurbines.htm
Cayuga County, New York. Cayuga County is constructing a facility to turn waste from local dairy farms and food processors into biofuels to produce electricity for local county buildings.	http://www.environmental-expert.com/resulteacharticle4.asp?cid = 6042&codi = 14509
Chesapeake, Virginia. Great Bridge Middle School South received a $240,000 geothermal heat exchange system in 1994 that reduces annual energy costs by more than $40,000.	http://www.geoexchange.org/pdf/cs-025.pdf

Chico, California. Chico has installed a combined 1.2 MW of PV power at two municipal facilities. The PV systems provide 19% of the city's municipal load and reduce carbon dioxide emissions by nearly 750 metric tons annually.	http://www.chico.ca.us/news_articles/NA_10_24_EPA_RECOGNIZES_THE_CITY_OF_CHI.asp
Culver City, California. The city council of Culver, California, which has proposed a resolution to require commercial and residential buildings in the city to install 1 kW of PV energy generation for every 10,000 square feet, estimates that the cost of purchasing and installing PV energy systems can be as low as $6,260 per kW.	http://www.energy.ca.gov/title24/2005standards/ordinances/2007-06-20_CULVER_CITY.PDF
Duluth, Minnesota. Duluth partnered with the Minnesota Department of Commerce, the State Energy Office, a local utility, and an ESCO to install a 2.4 kW PV array at the city's Main Library.	http://www.nmnrenewables.org/library/index.shtml
Haverhill, Massachusetts. The mayor of Haverhill has formed an Energy Task Force to develop recommendations for renewable energy projects in the town.	http://havenergy.civiczone.net/index.html
Hayward, California. The Hayward city council issued a resolution authorizing the installation of a solar power generating system at one of its buildings.	http://www.ci.hayward.ca.us/citygov/meetings/cca/rp/2005/rp022205-03.pdf
Hull, Massachusetts. The Hull municipal light department has installed two wind turbines with a combined capacity of approximately 2.5 MW. The town is currently studying the feasibility of installing four offshore wind turbines of 3 MW to 5 MW capacity each.	http://www.boston.com/news/local/articles/2006/02/24/wind_turbines_gaining_power/?page = 1
Kotzebue, Alaska. Kotzebue has installed wind turbines to provide electricity to its residents. Wind power provides an alternative to electricity generation from diesel generators, which require fuel that must be shipped over 1,200 miles.	http://www.aidea.org/aea/Reports%20and%20Presentations/Wind-Turbine-Provides_Electricity-for-Arctic-Town_CADDET-Kotzebue-Article.pdf
Mackinaw City, Michigan. Mackinaw City has installed two wind turbines that combined produce approximately 2,000,000 kWh annually.	http://www.mackinawcity.org/wind-turbines-42/
Minneapolis, Minnesota. Minneapolis has installed solar energy generating systems at three city buildings since 2005.	http://www.ci.minneapolis.mn.us/sustainability/solar.asp
Murray City, Utah. Murray City has adopted rules that require the municipal utility to provide bi-directional net-metering to customers who produce up to 10 kW of power from solar, wind, or hydroelectric sources.	http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code = UT11R&Search = TableType&type = Net&CurrentPageID = 7&EE = 0&RE = 1
North Bonneville, Washington. North Bonneville has installed a geothermal exchange system in its city hall. The system reduces energy costs by an estimated $1,500 annually.	http://www.geoexchange.org/pdf/cs-056.pdf
Phoenix, Arizona. Phoenix has installed PV equipment at multiple city government-owned and operated facilities.	http://phoenix.gov//PUBLICWORKS/solarproj.html
Portland, Oregon. The Portland Department of Transportation is using solar energy to power vehicles and parking meters. The Portland recycling facility runs on a 10 kW wind turbine.	http://www.portlandonline.com/osd/index.cfm?c = 42399
Spirit Lake, Iowa. The Spirit Lake Community School District has installed two wind turbines that provide enough electricity (about 2 million kWh annually) to power the entire school district.	http://www.greenpowergovs.org/wind/Spirit%20Lake%20case%20study.html

Yarmouth, Maine. Students at Yarmouth High School initiated a solar power project that involved the construction of a 3,600 kW system that offsets more than 4,000 pounds of CO_2 emissions annually.	http://www.maine.gov/mpuc/staying_informed/news/PRVRRFYarmouth10-23-2007.doc
Examples of Incentives for Residential or Commercial On-site Renewable Energy Generation	
Honolulu, Hawaii. The county of Honolulu offers qualified homeowners low-interest loans to install solar water heating systems at their homes.	http://www.co.honolulu.hi.us/dcs/solarloan.pdf
Huntington Beach, California. Huntington Beach has adopted an Energy-Efficient Permit Fee Waiver Program for solar equipment that produces renewable energy on-site, including PV systems and solar water heating systems.	http://www.hb-building.org/
Sacramento, California. The Sacramento California Municipal Utility District offers customers a rebate of $2.50 for every watt of solar energy generating capacity they install.	http://www.smud.org/green/solar/index.html
San Bernardino, California. The San Bernardino Board of Supervisors approved a waiver for building permit fees for installation of solar energy systems, wind turbines, tankless water heaters, and energy-efficient HVAC systems.	http://www.latimes.com/news/local/politics/cal/la-me-warming28aug28,1,7815153.story?coll = la-news-politics-california
Santa Clara, California. The city of Santa Clara offers residents the opportunity to rent city-owned PV equipment. Residents pay a small installation fee in addition to the costs of energy from the grid, but are allowed to keep the energy cost savings from the on-site renewable energy generated.	http://www.ci.santa-clara.ca.us/pub_utility/ws_water_heating.html
Thief River Falls, Minnesota. Thief River Falls offers local residents loans of up to $8,000 at 5% interest and a rebate of $2,000 for the installation of ground source heat pumps.	http://www.citytrf.net/Printable_forms.htm
Tucson, Arizona. The Tucson city council adopted a resolution that created a building permit credit for building projects that include solar power systems that produce at least 1,500 kWh per year.	http://www.dsireusa.org/documents/Incentives/AZ26F.htm
Examples of Ordinances Supporting Renewable Energy Generation	
Ashe County, North Carolina. In 2007, Ashe County passed a local ordinance that adopted regulations to streamline permitting of wind energy generation systems.	http://www.ashecountygov.com/PDFs/Ashe%20Co%20Windmill%20Ordinance071607.pdf
Fitchburg, Massachusetts. After several wind project applications were rejected, the Fitchburg city council directed the planning department to draft an ordinance to establish wind project permit specifications.	http://www.ci.fitchburg.ma.us/Wind_Ord_Intro.htm
Information Resources on On-site Renewable Energy Generation	
American Wind Energy Association. The American Wind Energy Association has a number of helpful resources available to consumers interested in on-site renewable energy, including fact sheets and cost estimates.	http://www.awea.org/pubs/
Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006. This DOE report provides statistics on national wind power capacity, turbine size and cost, wind power prices, and policy efforts driving wind power development.	http://www1.eere.energy.gov/windandhydro/pdfs/41435.pdf

APS Energy. APS Energy has partnered with multiple local governments to install solar energy systems at municipal facilities. This APS Energy Web site provides information on a sample of these projects.	http://www.aps.com/my_community/Solar/Solar_22.html
The Benefits of Distributed Resources to Local Governments: An Introduction. This NREL report describes the benefits to local governments of implementing distributed energy generation technologies, including on-site renewable energy generation.	http://www.clean-power.com/research/distributedgeneration/DGandLocalGoverments.pdf
Community Jobs in the Green Economy. This Apollo Alliance and Urban Habitat report describes the potential for job creation from investing in energy efficiency and renewable energy.	http://home.apolloalliance.org/community-jobs-report/Community-Jobs-in-the-Green-Economy.pdf
Distributed Energy Resources Guide. The California Energy Commission has developed an online guide on the technological and economic characteristics of several clean energy generation technologies.	http://www.energy.ca.gov/distgen/equipment/equipment.html
FEMP Renewable Energy. The DOE FEMP program provides information on federal government initiatives for using renewable energy, including on-site generation.	http://www1.eere.energy.gov/femp/renewable_energy/index.html
Cutting Costs with Energy Efficiency and Conservation: A Guide for Local Government Agencies. This Flex Your Power best practices guide provides information on local government opportunities to enhance energy efficiency in their agencies. The guide includes a chapter on using solar energy systems.	http://www.fypower.org/bpg/module.html?b = institutional&m = Distributed_Generation&s = Solar_Energy
Fuel Cell Technology. This Web site, developed as a component of the Whole Building Design Guide, provides information on fuel cell technologies and applications.	http://www.wbdg.org/design/fuelcell.php
Fuel Cells. This EPA fact sheet presents the benefits and costs behind fuel cell technology as a form of energy generation. It also addresses the barriers to large-scale fuel cell technology adoption.	http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BULTK/$File/fuelcells.pdf
Geothermal Energy in County Facilities. The National Association of Counties has developed this resource to provide information on the costs and benefits of applying geothermal technologies in local government facilities.	http://www.naco.org/GreenTemplate.cfm?Section = Energy_and_Green_Buildings&template = /ContentManagement/ContentDisplay.cfm&ContentID = 24365
Geothermal Heat Pumps. This DOE Web site provides information on the basics of geothermal exchange. The site includes fact sheets on the logistics of using geothermal heat pumps in different building types.	http://www1.eere.energy.gov/geothermal/heatpumps.html
Geothermal Resources Maps. DOE has collected information on the location of geologic resources that could make geothermal applications potentially feasible.	http://www1.eere.energy.gov/geothermal/maps.html
Government Facilities Case Studies. The Geo-thermal Heat Pump Consortium has collected fact sheets on municipal government examples of geothermal applications.	http://www.geoexchange.org/federal/case.htm
Guide to Photovoltaic System Design and Installation. This California Energy Commission guidebook provides information on issues to consider when designing and installing PV solar power systems.	http://www.abcsolar.com/pdf/2001-09-04_500-01-020.pdf

Guide to Purchasing Green Power. This EPA guide provides information on purchasing green power. Chapter 7 addresses on-site renewable energy projects.	http://www.epa.gov/greenpower/pdf/purchasing_guide_for_web.pdf
High Performance Technologies: Solar Thermal & Photovoltaic Systems. This DOE report provides information on building zero-energy homes using solar thermal and PV technologies. Local governments can find information on site planning and orientation of solar thermal and PV applications.	http://www.eere.energy.gov/buildings/building_america/pdfs/41085.pdf
Green Power from Landfill Gas. This EPA fact sheet provides information and statistics on how landfills can be used to produce electricity in a manner that is protective of natural resources.	http://www.epa.gov/lmop/docs/LMOPGreenPower.pdf
Jobs from Renewable Energy and Energy Efficiency. This fact sheet provides information on existing and projected energy efficiency- and renewable energy-related jobs in the U.S. by sector.	http://www.eesi.org/briefings/2007/Energy%20&%20Climate/11-8-07_green_jobs/EEREJobsFactSheet_11-8-07.pdf
Local Government and Community Programs and Incentives for Renewable Energy – National Report. This report by the North Carolina Solar Center provides information on the renewable energy programs and incentives administered by 45 local governments in 23 states.	http://www.abcsolar.com/pdf/federalreport.pdf
Money from the Sun: An Investor's Guide to Solar-Electric Profits. This article describes the long term benefits of investing in solar energy systems.	http://www.scottsdaleaz.gov/Assets/documents/greenbuilding/SolarEconomics.pdf
Potential for Energy Efficiency, Demand Response, and On-site Renewable Energy to Meet Texas's Growing Electricity Needs. This ACEEE report provides policy recommendations to meet growing energy demand in Texas. Recommendations include development of the public buildings program and providing incentives for onsite renewable energy.	http://aceee.org/pubs/E073.htm
Power Quality Problems and Renewable Energy Solutions. This Massachusetts Technology Collaborative report looks at the relative benefits of renewable energy compared to conventional energy generation with regard to power reliability, power quality, and power availability.	http://www.mtpc.org/Project%20Deliverables/PP_General_Power_Quality_Study.pdf
Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate. This University of California – Berkeley report shows the economic benefits of investing in renewable energy in terms of jobs created.	http://rael.berkeley.edu/files/2004/Kammen-Renewable-Jobs-2004.pdf
Renewable Energy and Distributed Generation Guidebook. This Massachusetts Division of Energy Resources report provides an overview of implementation issues associated with siting and generating distributed energy and connecting to the grid.	http://www.mass.gov/Eoca/docs/doer/pub_info/guidebook.pdf
Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century. This report was developed by the American Solar Energy Society to describe the existing and projected breakdown of renewable energy and energy efficiency-related employment in the United States.	http://www.ases.org/ASES-JobsReport-Final.pdf
Renewable Energy Basics. NREL provides basic information on seven forms of renewable energy applications.	http://www.nrel.gov/learning/re_basics.html

The Role of Distributed Generation in Power Quality and Reliability. This NYSERDA report assesses the power quality and supply reliability benefits of distributed generation technologies, including on-site renewable energy generation.	http://www.eea-inc.com/dgchp_reports/The_Role_of_DG_in_Power_Quality_Final_Report_R1.pdf
Single, Paired, and Aggregated Anaerobic Digester Options. This study presents an overview of the feasibility of installing anaerobic digesters to turn dairy farm waste into usable biofuels.	http://www.manuremanagement.cornell.edu/Docs/Perry%20Feas%20Study%20fact%20sheet%20FINAL%205-31-05.pdf
Solar America Initiative. In 2007, DOE commenced the Solar America Initiative to accelerate solar power applications in 13 model cities across the U.S.	http://www1.eere.energy.gov/solar/solar_america/pdfs/41760.pdf
Solar Water Heaters for Swimming Pools. This fact sheet provides information on the technical aspects and benefits of installing solar water heaters on swimming pools.	http://www.infinitepower.org/newfact/new96-825-No11.pdf
Using Distributed Energy Resources. This DOE fact sheet provides an overview of the benefits of using distributed energy resources, such as on-site energy generating technologies, and describes the process for determining the need for distributed energy resources at a facility.	http://www1.eere.energy.gov/femp/pdfs/31570.pdf
Wind Energy Economics. The Iowa Energy Center has developed this resource to provide information on the cost-effectiveness of wind turbines.	http://www.energy.iastate.edu/renewable/wind/wem/wem-13_econ.html
Resources on Financing for On-site Renewable Energy Generation	
The Borrower's Guide to Financing Solar Energy Systems. This brochure provides an overview of financial assistance opportunities offered by the federal government and private lenders for the installation of on-site renewable energy systems.	http://www.nrel.gov/docs/fy99osti/26242.pdf
Companies Financing Solar, Wind, and Other Renewable Energy Systems. The California Energy Commission has compiled a list of private financers for on-site renewable energy generation systems.	http://www.consumerenergycenter.org/erprebate/financial_companies.html
DSIRE. The Database of State Incentives for Renewable Energy provides information on state and local government renewable energy and energy efficiency incentives.	http://www.dsireusa.org/
Energy Tax Incentives. The Tax Incentives Assistance Project, a collaborative of non-profit organizations, government agencies, and other stakeholders, provides consumers and businesses with information on incentives available through the federal Energy Policy Act of 2005.	http://www.energytaxincentives.org/
Federal Grants. The Federal grants.gov program provides information on financial incentives available from 26 government agencies for a range of investments, including renewable energy generation.	http://www.grants.gov/
Handbook on Renewable Energy Financing for Rural Colorado. This handbook provides information on state and federal resources for financing renewable energy projects in Colorado. Many of the resources identified may be relevant to local governments outside Colorado.	http://www.colorado.gov/oemc/publications/handbook_rural_co.pdf
Incentives for Geo-Exchange Systems. This Web site provides information on various federal and state incentives for geothermal energy systems available to local governments.	http://www.geoexchange.org/incentives/incentives.htm

Innovations in Renewable Energy Financing. This National Renewable Energy Laboratory paper provides information on new strategies for financing renewable energy projects, including REC sales.	http://www.usaee.org/usaee2007/submissions/OnlineProceedings/Innovations%20in%20Renewable%20Energy%20Financing%20_Cory_%20-%20FINAL.pdf
Technical Issues Concerning Third Party Financing for Renewable Energy. This Web site was developed by the Sandia National Laboratories to provide information on the relative benefits of different third-party financing models for purchasing renewable energy generation systems.	http://energy.sandia.gov/technicallissues.htm
Tools for Screening On-site Renewable Energy Generation Applications	
Clean Power Estimator. This tool provides quick cost-benefit analysis for PV, solar thermal, wind, and energy efficiency technologies for residential and commercial buildings in specified geographic regions.	http://www.consumerenergycenter.org/renewables/estimator/index.html
eGRID. EPA's eGRID is a comprehensive source of data on the environmental characteristics of domestic electric power generation. It compiles data from 24 federal sources on emissions and resource mixes for virtually every power plant and company that generates electricity in the United States. It also provides user search options, including aspects of individual power plants, generating companies, states, and regions of the power grid.	http://www.epa.gov/cleanenergy/egrid/index.htm
EPA Power Profiler Tool. This EPA tool provides emission factors for a given region to help calculate the pollution benefits of energy savings. Users enter a ZIP code and specify their electric utility. This tool uses information from EPA's eGRID database of emissions and electricity generation data.	http://www.epa.gov/cleanenergy/powerprofiler.htm
Find Solar. Find Solar is a collaborative project involving DOE and the American Solar Energy Society that enables a user to calculate the costs, savings, and GHG emissions reductions of converting a portion of a building's energy use to solar generation.	http://www.findsolar.com/index.php?page = rightforme
FRESA. The Federal Renewable Energy Screening Application was developed by DOE as a tool for assessing the comparative benefits of different renewable energy applications at federal facilities.	http://www1.eere.energy.gov/femp/information/download_fresa.html
ProForm. This tool, developed by LBNL, calculates the financial indicators and reduced GHG emissions of renewable energy projects.	http://poet.lbl.gov/Proform/
PV Watts. This NREL performance calculator estimates the energy and cost savings from grid-connected PV systems from various locations around the country. The user can adjust various data assumptions to accommodate for regional and system specifics.	http://rredc.nrel.gov/solar/calculators/PVWATTS/
RETScreen. This tool was developed by the Canada national Natural Resources department to evaluate the energy production and savings, emissions reductions, and financial viability of different types of energy efficiency and renewable energy investments, including on-site renewable energy generation.	http://www.retscreen.net/ang/d_o_view.php

References

Albuquerque. 2005. Resolution R-05-329: Adopting Policies to Establish and Implement a City Renewable Energy Initiative. Available: http://www.cabq.gov/energy/documents/Resolution329.doc. Accessed 7/17/2007.

Anaheim. 2001. Anaheim Public Utilities Advantage Services Incentive Programs Recognized by State Association. Available: http://www.anaheim.net/utilities/news/article.asp?id = 245. Accessed 9/28/2007.

Ann Arbor. 2008. 5,000 Solar Roofs. Available: http://www.a2gov.org/government/publicservices/systems_planning/energy/energychallenge/Pages/SolarRoofs.aspx. Accessed 3/12/2008.

Apollo Alliance. 2006. New Energy for Cities. Available: http://www.apolloalliance.org/docUploads/new_energy_cities.pdf. Accessed 7/17/2007.

Apollo Alliance. 2007. Community Jobs in the Green Economy. Available: http://home.apolloalliance.org/community-jobs-report/Community-Jobs-in-the-Green-Economy.pdf. Accessed 7/5/2007.

Ashland. 2007. Ashland Solar Pioneer Program. Available: http://www.ashland.or.us/Page.asp?NavID = 1534. Accessed 7/18/2007.

Austin. 2007. Austin Climate Protection Plan. Available: http://www.ci.austin.tx.us/council/downloads/mw_acpp_points.pdf. Accessed 7/18/2007.

Austin Energy. 2002. Fuel Cell Project Installation. Available: http://havenergy.civiczone.net/index.html. Accessed 7/18/2007.

Austin Energy. 2007. Rebates and Loans. Available: http://www.austinenergy.com/Energy%20Efficiency/Programs/Green%20Building/Programs/rebatesLoans.htm. Accessed 7/26/2007.

AWEA. 2007. Wind Energy Basics. Available: http://www.awea.org/faq/wwt_basics.html. Accessed 9/27/2007.

AWEA. 2007b. The Economics of Small Wind. Available: http://www.awea.org/smallwind/toolbox2/factsheet_econ_of_smallwind.html. Accessed 7/9/2007.

Battle Creek. 2007. Honeywell Helps City of Battle Creek Meet its Renewable Energy Goals. Available: http://www.honeywell.com/sites/honeywell/casestudy3_cat181ec08-fbaa1ed448-3e3e4447ab3472a0c2a5e5fdc1e6517d_H1A1FA91C-7D69-6FFB-4828-79E7AF264661.htm. Accessed 3/11/2008.

Bend. 2007. Solar Services Agreement. Available: http://www.ci.bend.or.us/city_hall/meeting_minutes/docs/IS_SunEnergy_Solar_Agreements.pdf. Accessed 1/31/2008.

Berkeley. 2007. Sustainable Energy Financing District. Available: http://www.ci.berkeley.ca.us/mayor/GHG/SEFD-summary.htm. Accessed 1/11/2008.

Berkeley. 2007b. Services, Incentives, and Energy Rebate Programs. Available: http://www.cityofberkeley.info/sustainable/residents/ResSidebar/EnergyServices.html. Accessed 7/26/2007.

Boston. 2007. Executive Order: Relative to Climate Action in Boston. Available: http://www.cityofboston.gov/environmentalandenergy/pdfs/Clim_Action_Exec_Or.pdf. Accessed 3/28/2008.

Boston. 2007b. Sustainability Accomplishments. Available: http://www.cityofboston.gov/environmentalandenergy/pdfs/sus_accom.pdf. Accessed 3/27/2008.

Boston. 2008. Boston Plans Wind Turbines for City Hall, Schools. Available: http://boston.about.com/od/governmentcityservices/a/WindTurbines.htm. Accessed 3/11/2008.

Boston. 2008b. Thinking BIG About Boston's Solar Energy Future. Available: http://www.cityofboston.gov/climate/pdfs/SolarBostonPresentation-1-10-08.pdf. Accessed 3/27/2008.

Boston. 2008c. Wind Energy. Available: http://www.cityofboston.gov/environmentalandenergy/wind.asp. Accessed 3/27/2008.

Boston. 2008d. Solar Boston. Available: http://www.cityofboston.gov/climate/solar.asp. Accessed 3/27/2008.

Boston. 2008e. Mayor Announces Plans for Wind Turbines. Available: http://www.cityofboston.gov/climate/solar.asp. Accessed 3/27/2008.

Boulder. 2008. Sustainable Energy Plan. Available: http://www.bouldercounty.org/sustain/pdf/SEP_final_draft.pdf. Accessed 4/14/2008.

BUSD. 2007. Resolution Number 07-52. Available: http://www.berkeley.k12.ca.us/SB/docs/bd_of_ed_june_20_07_packet.pdf. Accessed 9/28/2007.

Butler. 2008. City's Planning Board Finalizes its Wind Energy Ordinance. *Sentinel and Enterprise.* 12 January 2008. Available: http://www.sentinelandenterprise.com/mobile/ci_7953816. Accessed 1/28/2008.

California Assembly. 2001. Chapter 562: An Act Relating to Wind Energy. Available: http://www.leginfo.ca.gov/pub/01-02/bill/asm/ab_1201-1250/ab_1207_bill_20011007_chaptered.pdf. Accessed 7/6/2007.

Cayuga County. 2007. Cayuga County, New York Pioneers Community Digester Program. Available: http://www.environmental-expert.com/resulteacharticle4.asp?cid = 6042&codi = 14509. Accessed 7/18/2007.

CEC. 2001. Guide to PV System Design and Installation. Available: http://www.energy.ca.gov/reports/2001-09-04_500-01-020.PDF. Accessed 9/27/2007.

CEC. 2007a. DER Equipment – Photovoltaic Systems. Available: http://www.energy.ca.gov/distgen/equipment/photovoltaic/cost.html. Accessed 7/19/2007.

CEC. 2007b. DER Equipment – Fuel Cells. Available: http://www.energy.ca.gov/distgen/equipment/fuel_cells/cost.html. Accessed 7/19/2007.

CEC. 2007c. DER Equipment: Microturbines. Available: http://www.energy.ca.gov/distgen/equipment/microturbines/cost.html. Accessed 10/1/2007.

CEC. 2007d. DER Equipment: Reciprocating Engines. Available: http://www.energy.ca.gov/distgen/equipment/reciprocating_engines/cost.html. Accessed 10/1/2007.

CEC. 2007e. Companies Financing Energy Systems. Available: http://www.consumerenergycenter.org/erprebate/financial_companies.html. Accessed 3/12/2008.

Chevron. 2007. From Waste to Watts: City of Rialto Teams with Chevron, Fuel Cell Energy to Turn Restaurant Grease into Renewable Power. Available: http://www.chevron.com/news/press/2007/2007-05-08.asp. Accessed 9/28/2007.

Chicago. 2008. Chicago Solar Partnership: Solar Benefits. Available: http://www.chicagosolarpartnership.org/index.php?submenu = About&src = gendocs&link = Benefits&category = About%20Us#jobs. Accessed 1/29/2008.

DSIRE. 2007a. Pike County – Wind Turbine Siting Standards. Available: http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code = IL08R&state = IL&CurrentPageID = 1&RE = 1&EE = 0. Accessed 7/9/2007.

DSIRE. 2007b. Lakeland Electric – Solar Water Heating Program. Available: http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code = FL51F&state = FL&CurrentPageID = 1&RE = 1&EE = 1. Accessed 7/9/2007.

DSIRE. 2007c. Rockingham County – Small Wind Ordinance. Available: http://dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code = VA07R&Search = TableType&type = Constr&CurrentPageID = 7&EE = 1&RE = 1. Accessed 7/18/2007.

DSIRE. 2007d. Yellow Springs Utilities – Net Metering. Available: http://www.yso.com/ordinances/pdf/1042.pdf. Accessed 7/18/2007.

DSIRE. 2007e. San Francisco – Renewable Energy Purchasing. Available: http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code = CA43R&state = CA&CurrentPageID = 1&RE = 1&EE = 1. Accessed 7/18/2007.

DSIRE. 2007f. Columbia – Renewable Portfolio Standard. Available: http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code = MO04R&Search = TableType&type = RPS&CurrentPageID = 7&EE = 1&RE = 1. Accessed 7/18/2007.

DSIRE. 2007g. City of New Orleans – Net Metering. Available: http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code = LA05R&state = LA&CurrentPageID = 1&RE = 1&EE = 1. Accessed 7/19/2007.

DSIRE. 2007h. Honolulu Solar Bond Program. Available: http://www.dsireusa.org/library/includes/GenericIncentive.cfm?Incentive_Code = HI17F&currentpageid = 3&EE = 1&RE = 1. Accessed 1/28/2008.

DSIRE. 2007i. Harford County – Property Tax Credit for Solar Heating and Cooling. Available: http://www.dsireusa.org/library/includes/incentivesearch.cfm?Incentive_Code = MD24F&Search = Type&type = Property&CurrentPageID = 2&EE = 0&RE = 1. Accessed 1/31/2008.

Duluth. 2002. Duluth Public Library. Available: http://www.nmnrenewables.org/library/index.shtml. Accessed 7/19/2007.

EIA. 2003. Biomass for Electricity Generation. Available: http://www.eia.doe.gov/oiaf/analysispaper/biomass/table7.html. Accessed 10/1/2007.

EIA. 2007. Generation and Consumption of Fuels for Electricity Generation, May 2007. Available: http://www.eia.doe.gov/cneaf/electricity/epm/epm_sum.html. Accessed 8/20/2007.

Ellensburg. 2007. Ellensburg Solar Community. Available: http://www.solarwashington.org/Calendar/events/2007/ESC-Overview.pdf. Accessed 7/18/2007.

Energy Services Bulletin. 2004. Lenox wind turbine generates power, interest in renewable energy. Available: http://www.wapa.gov/ES/pubs/esb/2004/feb/feb043.htm. Accessed 1/29/2008.

Energy Vortex. 2003. Auburn Preserves City Hall, Improves Employee Comfort with Innovative Heating and Cooling System. Available: http://www.energyvortex.com/pages/headlinedetails.cfm?id = 1304&archive = 1. Accessed 1/29/2008.

Gang, D. W. 2007. San Bernardino County Vows to Protect Environment. *Press-Enterprise*, 28 August, 2007. Available: http://www.pe.com/. Accessed 1/29/2008.

GeoExchange. 1997. North Bonneville City Hall, North Bonneville, Washington. Available: http://www.geoexchange.org/pdf/cs-056.pdf. Accessed 7/17/2007.

Green Jobs. 2007. Methane Generator, Energy Conservation Benefit the City of Sparks. Available: http://www.greenjobs.com/Public/IndustryNews/inews02542.htm. Accessed 7/6/2007.

Hayward. 2005. Resolution Authorizing the Installation of a Solar Power Electrical Generating System Atop the City's Barnes Court Warehouse. Available: http://www.ci.hayward.ca.us/citygov/meetings/cca/rp/2005/rp022205-03.pdf. Accessed 7/10/2007.

Highland Beach. 2006. Highland Beach "Green" Town Hall. Available: http://www.dnr.state.md.us/ed/pdfs/HighlandBeach.pdf. Accessed 3/12/2008.

Hoff, T. 2000. The Benefits of Distributed Resources to Local Governments: An Introduction. Available: http://www.clean-power.com/research/distributedgeneration/DGandLocalGoverments.pdf. Accessed 7/5/2007.

Honeywell. 2006. Solar Canopy Generates Savings, Lightens Tax Burden. Available: https://buildingsolutions.honeywell.com/NR/rdonlyres/E008D8D8-B91E-4153-BD85-5AC8BC4CDC10/59152/e008d8d8b91e4153bd855ac8bc4cdc10.pdf. Accessed 1/30/2008.

Howard County. 2006. Property Tax Code Section 9-203. Available:. Accessed 1/31/2008.

Hull. 2008. Hull Wind. Available: http://www.hullwind.org/. Accessed 1/29/2008.

ICLEI. Undated. Case Study: Waverly, Iowa. Available: http://www.greenpowergovs.org/wind/Waverly%20case%20study.html. Accessed 7/19/2007.

ICECF. 2006. Summary of Foundation Grants. Available: http://www.illinoiscleanenergy.org/images/ICEFC_PDFs/ICECF%20Update%207-06.pdf. Accessed 7/18/2007.

ICECF. 2008. About the Foundation. Available: http://www.illinoiscleanenergy.org/about.asp. Accessed 4/8/2008.

IREC. 2007. Net Metering. Available: http://www.dsireusa.org/documents/SummaryMaps/NetMetering_Map.ppt. Accessed 7/25/2007.

IREC. 2008. Solar Boston: Creating a Citywide Solar Strategy for the City of Boston. Available: http://www.irecusa.org/index.php?id = 68&tx_ttnews[pS] = 1203364584&tx_ttnews[tt_news] = 914&tx_ttnews[backPid] = 70&cHash = 8da3f996b1. Accessed 3/11/2008.

Lake Washington School District. 2006. Redmond High School completes Solar Installation Project with Puget Sound Energy's Support. Available: http://www.lkwash.wednet.edu/lwsd/html/news/storyDetail.asp?storyId = 573. Accessed 7/19/2007.

LBNL. 2002. Berkeley Lab and the Clean Energy Group: Case Studies of State Support for Renewable Energy. Available: http://eetd.lbl.gov/ea/ems/cases/Bulk_Purchases.pdf. Accessed 1/29/2008.

LIHI. 2003. Skagit is Largest Hydropower Project to Earn Certification as Low Impact. Available: http://lowimpacthydro.org/application-details.aspx?id = 6. Accessed 1/29/2008.

LIHI. 2008. Low-Impact Hydropower Institute. Available: http://lowimpacthydro.org/cf.aspx. Accessed 1/29/2008.

Maricopa Association of Governments. 2002. Permit Submittal Requirements for PV Systems. Available: http://www.mag.maricopa.gov/pdf/cms.agendas/BCMay15attach_361.pdf. Accessed 7/19/2007.

Marin. 2008. Marin County Code, Section 20.20.030 Energy Conservation Code. Available: http://municipalcodes.lexisnexis.com/codes/marincounty/_DATA/TITLE20I/Chapter_20_20_DESIGN_AND_IMPRO.html#2. Accessed 1/28/2008.

Mason City. 2006. Zoning for Wind Energy Conversion Systems. Available: http://www.windustry.org/SmallWind/documents/MasonCityIAWindOrdinance.pdf. Accessed 7/19/2007.

MDER. 2007. Model Amendment to a Zoning Ordinance or By-Law: Allowing Wind Facilities by Special Permit. Available: http://www.mass.gov/Eoca/docs/doer/renew/model-allow-wind-by-permit.pdf. Accessed 1/29/2008.

Michigan DLEG. 2007. Michigan Siting Guidelines for Wind Energy Systems. Available: http://www.michigan.gov/documents/Wind_and_Solar_Siting_Guidlines_Draft_5_96872_7.pdf. Accessed 7/6/2007.

Minneapolis. 2007. Minneapolis Goes Solar. Available: http://www.ci.minneapolis.mn.us/sustainability/solar.asp. Accessed 7/10/2007.

MTC. 2002. Power Quality Problems and Renewable Energy Solutions. Available: http://www.mtpc.org/Project%20Deliverables/PP_General_Power_Quality_Study.pdf. Accessed 7/9/2007.

MTC. 2007. Renewable Energy Solutions for Greener Communities. Available: http://www.masstech.org/renewableenergy/greencommunities.html#SRI. Accessed 7/6/2007.

Multnomah County. 2005. Local Action Plan on Global Warming. Available: http://www2.co.multnomah.or.us/County_Management/Sustainability/sustainability_reports/Global%20Warming%20Progress%20county%20actions%202005.pdf. Accessed 9/26/2007.

New Jersey. 2006. NJBPU Unveils Largest East Cost Solar Project. Available: http://www.njcleanenergy.com/html/5library/press/pr_njbpu-largesolar.html. Accessed 7/6/2007.

Newton. 2005. Energy Action Plan. Available: http://www.greenenergynewton.org/sunergy/EAP021005.pdf. Accessed 9/28/2007.

NREL. 2007a. Solar Process Heating. Available: http://www.nrel.gov/learning/re_solar_process.html. Accessed 7/6/2007.

NREL. 2007b. Concentrating Solar Power. Available: http://www.nrel.gov/learning/re_csp.html. Accessed 7/6/2007.

NREL. 2007c. Solar Hot Water. Available: http://www.nrel.gov/learning/re_solar_hot_water.html. Accessed 7/6/2007.

NREL. 2007d. Innovations in Renewable Energy Financing. Available: http://www.usaee.org/usaee2007/submissions/OnlineProceedings/Innovations%20in%20Renewable%20Energy%20Financing%20_Cory_%20-%20FINAL.pdf. Accessed 1/30/2008.

NYSERDA. 2007. On-site or Small Wind Incentives. Available: http://www.powernaturally.org/Programs/Wind/incentives.asp?i = 8. Accessed 7/5/2007.

NYSERDA. 2007b. Power Naturally: FAQs. Available: http://www.powernaturally.org/About/FAQs.asp. Accessed 9/28/2007.

Pennsylvania. 2006. Governor Rendell Announces Scholarships for Local Government Officials to Attend Wind Energy Conference. Available: http://www.state.pa.us/papower/cwp/view.asp?Q = 452210&A = 11. Accessed 7/6/2007.

Phoenix. 2007. Solar and Other Renewable Energy Projects. Available: http://www.phoenix.gov/sustainability/solarproj.html. Accessed 7/19/2007.

Portland. 2007. Powered by the Sun and Wind! Available: http://www.portlandonline.com/osd/index.cfm?c = 42399&a = 117668. Accessed 7/19/2007.

Portsmouth. 2007. Wind Project for the High School and Middle School Feasibility Study. Available: http://www.portsmouthrienergy.com/schoolstudy9-07.htm. Accessed 9/27/2007.

PV Sustain. Undated. Factsheet. Available: http://pvsustain.com/solar_pv_factsheet.pdf. Accessed 10/1/2007.

REPP-CREST. Undated. Geothermal Resources. Available: http://www.crest.org/geothermal/geothermal_brief_economics.html. Accessed 10/1/2007.

Ryan, A. 2007. Federal Money Charges Portland Solar Effort. Available: http://www.djc-or.com/viewStory.cfm?recid = 29664&userID = 1. Accessed 7/17/2007.

San Diego. 2001. Status of City Energy Conservation Efforts. Available: http://clerkdoc.sannet.gov/RightSite//getcontent/local.pdf?DMW_OBJECTID = 09001451800819b6. Accessed 7/19/2007.

San Diego. 2007a. Important Facts and Figures. Available: http://www.sandiego.gov/economic-development/glance/sdfacts.shtml. Accessed 7/19/2007.

San Diego. 2007b. Energy Savings Projects. Available: http://www.sandiego.gov/environmental-services/energy/programsprojects/saving/renewable.shtml. Accessed 7/19/2007.

San Diego. 2007c. Energy Conservation & Management Division. Available: http://www.sandiego.gov/environmental-services/energy/. Accessed 7/19/2007.

San Diego. 2007d. San Diego School Buildings Going Green With PV Roof. Available: http://goliath.ecnext.com/coms2/gi_0199-6567530/San-Diego-School-buildings-going.html. Accessed 1/30/2008.

San Diego. 2007e. City of San Diego Unveils 1-Megawatt Solar System at City's Alvarado Water Treatment Plant. Available: http://www.renewableenergyaccess.com/rea/partner/story?id = 47619. Accessed 1/31/2008.

Sandia. 2007. Technical Issues Concerning Third Party Financing for Renewable Energy. Sandia National Laboratories. Available: http://energy.sandia.gov/technicallissues.htm. Accessed 1/30/2008.

San Francisco. 2007a. Mayor Newsome Announces Plan to Significantly Expand Solar, Renewable Energy Generation in San Francisco. Available: http://sfgov.org/site/mayor_index.asp?id = 55941. Accessed 10/1/2007.

San Francisco. 2007b. Mayor Newsom Unveils SFO/SFPUC Solar Energy Project. Available: http://sfgov.org/site/mayor_index.asp?id = 68140. Accessed 10/1/2007.

Santa Monica. 2007. Solar and Renewable Energy. Available: http://www.smgov.net/epd/residents/Energy/solar.htm. Accessed 7/20/2007.

SDREO. 2007. How much electricity will PV produce? Available: http://www.sdreo.org/ContentPage.asp?ContentID = 121&SectionID = 86&SectionTarget = 44. Accessed 9/28/2007.

Seattle Green Power. 2007. Meridian Park Elementary School. Available: http://www.ci.seattle.wa.us/light/Green/greenPower/Accomplishments/meridian.asp. Accessed 9/28/2007.

SMUD. 2007. Solar Power For Your Home. Available: http://www.smud.org/green/solar/index.html. Accessed 7/5/2007.

SMUD. 2007b. Folsom-SMUD partnership makes solar easier, more affordable. Available: http://www.smud.org/news/releases/07archive/11_28_07_smudfolsomsolar.pdf. Accessed 3/11/2008.

Stimmel, R. AWEA Small Wind Turbine Global Market Study. American Wind Energy Association. Available:

http://www.awea.org/smallwind/documents/AWEASmallWindMarketStudy2007.pdf. Accessed 7/25/2007.

Sulzberger, G. 2007. County Approves Solar Power Project. Available: http://www.oregonlive.com/printer/printer.ssf?/base/portland_news/1183083911307040.xml&coll = 7. Accessed 7/19/2007.

SWEEP. 2008. Southeast Service Center: Tucson, Arizona. Available: http://www.swenergy.org/casestudies/arizona/tucson_sesc.htm. Accessed 3/14/2008.

Tallahassee. 2007. Solar Power Net Metering. Available: http://www.talgov.com/you/electric/net_metering.cfm. Accessed 1/30/2008.

Tampa. 2007. Florida's Renewable Energy Source. Available: http://www.energyvortex.com/pages/headlinedetails.cfm?id = 1304&archive = 1. Accessed 1/29/2008.

Tucson. 2005. Resolution 20193. Available: http://www.dsireusa.org/documents/Incentives/AZ26F.htm. Accessed 7/25/2007.

U.S. Conference of Mayors. 2006. Energy & Environment Best Practices Guide. Available: http://usmayors.org/uscm/best_practices/EnergySummitBP06.pdf. Accessed 7/9/2007.

U.S. Conference of Mayors. 2007. Climate Protection Strategies and Best Practices Guide. Available: http://www.usmayors.org/climateprotection/documents/2007bestpractices-mcps.pdf. Accessed 4/8/2008.

U.S. DOE. 1999. Geothermal Heat Pumps for Medium and Large Buildings. Available: http://www.nd.gov/dcs/energy/pubs/renewable/geobuild.pdf. Accessed 7/9/2007.

U.S. DOE. 2003. Wind Power Pioneer Interview: Glenn Cannon, Waverly Light and Power. Available: http://www.eere.energy.gov/windandhydro/windpoweringamerica/filter_detail.asp?itemid = 688. Accessed 7/19/2007.

U.S. DOE. 2003b. Advanced Microturbine Systems. Available: http://www.eere.energy.gov/de/pdfs/microturbine_advanced_systems.pdf. Accessed 10/1/2007.

U.S. DOE. 2005. Small Wind Electric Systems: A U.S. Consumer's Guide. Available: http://www.eere.energy.gov/windandhydro/windpoweringamerica/pdfs/small_wind/small_wind_guide.pdf. Accessed 7/5/2007.

U.S. DOE. 2006a. Geothermal Heat Pumps. Available: http://www1.eere.energy.gov/geothermal/heatpumps.html. Accessed 7/9/2007.

U.S. DOE. 2006b. Net Metering. Available: http://www.eere.energy.gov/greenpower/markets/netmetering.shtml. Accessed 7/25/2007.

U.S. DOE. 2007b. Selecting and installing a Geothermal Heat Pump System. Available: http://www.eere.energy.gov/consumer/your_home/space_heating_cooling/index.cfm/mytopic = 12670. Accessed 7/19/2007.

U.S. DOE. 2007c. Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006. Available: http://www1.eere.energy.gov/windandhydro/pdfs/41435.pdf. Accessed 9/27/2007.

U.S. DOE. 2007d. California Cities and Counties Reduce or Eliminate Solar Permit Fees. Available: http://www.eere.energy.gov/state_energy_program/project_brief_detail.cfm/pb_id = 1179. Accessed 1/29/2008.

U.S. DOE. 2007e. Photovoltaics: The Basics. Available: http://www.eere.energy.gov/solar/cfm/faqs/third_level.cfm/name = Photovoltaics/cat = The%20Basics. Accessed 2/4/2008.

U.S. DOE. 2008. Department of Energy Selects Winner of Wind Cooperative of the Year Award. Available: http://www.energy.gov/news/6010.htm. Accessed 3/11/2008.

U.S. EPA. 1999. Brownfields and Land Revitalization. Available: http://www.epa.gov/swerosps/bf/html-doc/brightfd.htm. Accessed 9/26/2007.

U.S. EPA. 2000. Biomass Energy. Available: http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/SHSU5BNJXH/$File/biomassenergy.pdf. Accessed 7/6/2007.

U.S. EPA. 2004. Guide to Purchasing Green Power. Available: http://www.epa.gov/greenpower/buygreenpower/guide.htm. Accessed 7/6/2007.

U.S. EPA. 2004b. A Comparison of Dairy Cattle Manure Management with and without Anaerobic Digestion and Biogas Utilization. Available: http://www.epa.gov/agstar/pdf/nydairy2003.pdf. Accessed 9/26/2007.

U.S. EPA. 2005. ENERGY STAR Savings Calculator: Geothermal Heat Pumps. Available: http://energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorAirSourceHeatPump.xls. Accessed 3/28/2008.

U.S. EPA. 2006a. Electricity from Hydropower. Available: http://www.epa.gov/cleanrgy/hydro.htm. Accessed 7/9/2007.

U.S. EPA. 2006b. Clean Energy-Environment Guide to Action. Available: http://www.epa.gov/cleanenergy/pdf/gta/guide_action_full.pdf. Accessed 7/19/2007.

U.S. EPA. 2006c. Electricity from Municipal Solid Waste. Available: http://www.epa.gov/cleanenergy/muni.htm. Accessed 7/24/2007.

U.S. EPA. 2007a. Green Power Partnership – City of San Diego. Available: http://www.epa.gov/greenpower/partners/partners/cityofsandiegoca.htm. Accessed 7/19/2007.

U.S. EPA. 2007b. What is Renewable Energy? Available: http://www.epa.gov/greenpower/whatis/renewableenergy.htm. Accessed 7/25/2007.

U.S. EPA. 2007c. Office Building Energy Use Profile. Available: http://epa.gov/cleanrgy/pdf/sector_meeting27Jun07/4bi_officebuilding.pdf. Accessed 9/28/2007.

U.S. EPA. 2007e. Green Power Partnership: Green Power Defined. Available: http://www.epa.gov/greenpower/gpmarket/index.htm. Accessed 4/8/2008.

U.S. EPA. 2007f. Green Power Partnership: Glossary. Available: http://www.epa.gov/greenpower/pubs/glossary.htm. Accessed 4/8/2008.

U.S. EPA. 2008. Air Emissions. Available: http://www.epa.gov/cleanenergy/energy-and-you/affect/air-emissions.html. Accessed 3/28/2008.

U.S. EPA. 2008b. Benefits of LFG Energy. Available: http://www.epa.gov/lmop/benefits.htm. Accessed 3/28/2008.

U.S. EPA. 2008c. Program Information: EPA Green Power Partnership. April 2008.

U.S. EPA. Undated. Green Power from Landfill Gas. Available: http://www.epa.gov/lmop/docs/LMOPGreenPower.pdf. Accessed 9/28/2007.

U.S. Mayors. 2007. Best Practices Guide. Available: http://www.usmayors.org/uscm/best_practices/EandEBP07.pdf. Accessed 1/31/2008.

Waverly. 2007. City of Waverly. Available: http://city.waverlyia.com/. Accessed 7/19/2007.

WBDG. 2007. Fuel Cells. Available: http://www.wbdg.org/resources/fuelcell.php. Accessed 10/1/2007.

WLP. 2005. Greenhouse Gas Report. Available: http://wlp.waverlyia.com/docs/Copy%20of%20WLP-2005Report.pdf. Accessed 7/19/2007.

WLP. 2006. Renewables Production 2006. Available: http://wlp.waverlyia.com/docs/Renewables%20file.pdf. Accessed 7/19/2007.

WLP. 2007a. Waverly Light and Power Purchases Two Wind Turbines. Available: http://wlp.waverlyia.com/headline.asp?obj_id = 1092. Accessed 7/19/2007.

WLP. 2007b. Renewable Energy. Available: http://wlp.waverlyia.com/renewable_energy.asp. Accessed 7/19/2007.

WRI. 2007. The Solar Services Model: An Innovative Financing Approach to On-site Solar Photovoltaics. Available: http://www.thegreenpowergroup.org/pdf/case_studies_Staples_2.pdf. Accessed 1/31/2008.