CHAPTER TWO

Potential Lead By Example Activities and Measures

State governments are planning and implementing LBE programs with the goals of:

- Reducing energy use and energy costs,
- Demonstrating the cost competitiveness of clean energy activities,
- Reducing greenhouse gas (GHG) emissions and other environmental impacts,
- Improving energy supply reliability, and
- Achieving additional energy, environmental, economic, and other benefits.

Comprehensive programs typically include multiple LBE activities and measures, six of which are described in this chapter. The following information is provided for each:

- The benefits of LBE activities and measures,
- Planning and implementation strategies, and
- State and local government examples associated with the activity.

The descriptions of the six key activities presented in this chapter provide information for states to use as they develop their LBE program. For example, when setting LBE program goals and establishing an LBE team (see Chapter 3, *Establish the LBE Program Framework*), a state can draw on information about the key goals, objectives, and participants for each of the activities being considered for inclusion in the overall LBE program. States can likewise use the activity-specific information on costs, benefits, and feasibility when screening potential activities for incorporation into the

DOCUMENT MAP

CHAPTER TWO CONTENTS

Related appendices:

Appendix B, State and Local Clean Energy LBE Programs: Examples, Tools, and Information Resources. This appendix presents examples of state and local LBE activities, as well as resources for each of the activities described in this chapter.

LBE program (see Chapter 4, *Screen LBE Activities and Measures*). Similarly, this chapter presents information on implementation strategies and best practices that can be incorporated into a comprehensive LBE program (see Chapter 5, *Develop a Comprehensive LBE Program*).

To assist states in applying the information provided here, Table 2.6.1 (at the end of this chapter) presents a suite of LBE-related databases and best-practice resources.

THE LBE GUIDE AND THE CLEAN ENERGY-ENVIRONMENT GUIDE TO ACTION

Leading by example is a key policy option for states seeking to achieve clean energy goals. For a primer on LBE actions and opportunities, readers can view Section 3.1 of EPA's Clean Energy-Environment Guide to Action, a recent document that describes and provides core information on sixteen clean energy policies.

This Section provides an overview of how to develop a state LBE program, including information on program objectives and benefits; best practices for designing, implementing, and evaluating an LBE program; state examples; and resources.

The LBE Guide is an important next step in EPA's efforts to assist states as they develop clean energy policies and projects. It extends and supports the information presented in EPA's Clean Energy-Environment Guide to Action.

Source: U.S. EPA, 2006a.

2.1 ENERGY EFFICIENCY IN GOVERNMENT BUILDINGS

Owned and leased facilities are an important focus of many states' comprehensive LBE programs. State and local governments are responsible for more than 16 billion square feet of building space, with state facilities (including office buildings, libraries, prisons, universities, and other facilities) accounting for approximately 5% of the nation's non-residential building space). Combined, state and local governments spend more than $11 billion annually[1] on energy costs, which can account for as much as 10% of a typical government's annual operating budget (ACEEE, 2003, U.S. DOE, 2007h).

A state government's building portfolio makeup can have a significant influence on its total energy use and costs. For example, energy consumption per square foot can vary by type of facility. As shown in the text box on the right, state universities typically use more energy per square foot than state office buildings and other state facilities (e.g., prisons, courthouses) (EIA, 2003; South Carolina, 2006).

As shown in the text box on page 2-3, *Energy Use in Government Buildings*, state facility energy consumption is largely used for lighting, space conditioning, water heating, office equipment and other miscellaneous purposes that can account for as much as 90% of the GHG emissions from state government operations (Massachusetts, 2004). Thus, the growing number of states taking steps to manage their energy use and increase the energy efficiency of their building portfolios are achieving significant financial and environmental results.

STATE GOVERNMENT BUILDING PORTFOLIOS

State governments own and operate several types of facilities, including office buildings, libraries, prisons, and universities, that each has unique energy use characteristics. According to data from the 1999 Commercial Building Energy Consumption Survey, conducted by the Energy Information Administration and updated in 2003, the average government-owned office buildings uses 114,000 Btu per square foot, while the average university and public order/safety buildings (e.g., courthouses, prisons, reformatories) use 145,000 Btu per square foot and 87,000 Btu per square foot, respectively.

Thus, the composition of a state government's building portfolio can have a significant influence on its total energy use and costs. The table below shows the breakdown of energy use in state-owned facilities in South Carolina for FY 2004.

Institution	Total Square Feet (in millions)	Total Energy Costs (in millions)	Average Cost per Square Foot	Average kBtu per Square Foot
School Districts	107	$104	$0.96	46
State Agencies	24	$38	$1.58	118
Public Colleges with Housing	30	$47	$1.39	124
Colleges without Housing	8	$10	$1.25	72
Total	169	$199	$1.12	70

Sources: EIA, 2003; South Carolina, 2006.

[1] *Estimates of combined state and local government energy expenditures range from $10 billion annually to $19 billion annually (EIA, 2003a, U.S. DOE, 2007h; U.S. EPA, 2008v; Harris et al., 2003). Estimates of square footage of state and local building space also vary by source. The U.S. DOE Energy Information Administration, for example, estimated that in 2003, state and local governments account for about 13 billion square feet of floor space (EIA, 2003a).*

2.1.1 BENEFITS OF IMPROVING ENERGY EFFICIENCY IN GOVERNMENT BUILDINGS

Government leadership in improving energy efficiency across state facility portfolios can produce significant energy, environmental, economic, and other benefits, including:

- *Reduced energy costs*. Significant cost savings can be achieved by improving energy efficiency in existing buildings, leasing energy-efficient buildings, and designing new buildings to be energy efficient. For a typical office building, energy represents 30% of the variable costs of the building and constitutes the single largest controllable operating cost (NAPEE, 2008).

The lifetime energy cost savings produced by an energy-efficient building compared to a conventional one can reach millions of dollars (NAPEE, 2008). Information on the potential energy savings from improving energy efficiency in government buildings includes:

- Energy cost savings on the order of 35% or more are possible for many existing buildings (U.S. EPA, 2008x).
- Many new and renovated buildings designed for energy efficiency offer energy cost savings of as much as 50% compared to conventional buildings (U.S. EPA, 2008n).
- For some buildings, responsible operations and maintenance (O&M) practices, which can often be implemented at low- or no-cost, can account for 5% to 20% of total energy cost savings (U.S. DOE, 2006b).
- Buildings that have achieved the ENERGY STAR label for superior energy efficiency use 40% less energy than average buildings, and offer savings of about $0.50 per square foot per year in lower energy costs, based on a conservative estimate (U.S. EPA, 2006l; U.S. EPA, 2006m).

For an average state, reducing state government energy consumption by 20% overall – a common state target (see Table 3.4.1, *Examples of LBE Goals and Targets*) – could reduce annual state government energy costs by about $16 million while saving nearly 1.2 trillion Btu annually in energy use (ACEEE, 2003). In New York, where a 2001 executive order directed state agencies to reduce energy consumption by 35% by 2010 relative to 1990 levels, the state saved $54.4 million in energy costs from energy efficiency improvements between FY 2001/2002 and FY 2003/2004 (NYSERDA, 2005).

ENERGY USE IN GOVERNMENT BUILDINGS

This table presents average annual energy use by federal, state, and local government-owned commercial buildings (any building that is not residential, industrial, manufacturing, or agricultural).*

End Use	Consumption (trillion Btu)**	As Percentage of Whole
Space heating	498	36
Lighting	294	21
Water heating	239	17
Miscellaneous	94	8
Office equipment	78	6
Space cooling	75	5
Ventilation	42	3
Cooking	28	2
Refrigeration	22	2
Total	1,370	100

*Data are from the 2003 Commercial Buildings Energy Consumption Survey (CBECS), conducted by the Energy Information Administration quadrennially. As of July 2008, data collection for the 2007 CBECS is in progress.

**Figures are rounded to the nearest trillion Btu.

Source: U.S. DOE, 2006a.

- *Reduced GHG emissions and other environmental impacts*. Improving energy efficiency in government buildings can help reduce GHG emissions and other environmental impacts by decreasing consumption of fossil fuel-based energy. Energy use in commercial and industrial facilities accounts for nearly 50% of all U.S. GHG emissions, and fossil fuel combustion for electricity generation accounts for 40% of the nation's CO_2 emissions, a principle GHG, 67% of the nation's SO_x emissions, and 23% of the nation's NO_x emissions (U.S. EPA, 2008n; U.S. EPA, 2008s). SO_x and NO_x emissions can lead to smog and acid rain, and result in emissions of trace amounts of airborne particulate matter that can cause respiratory problems for many people (U.S. EPA, 2008s). At the state level, energy use in buildings can account for as much as 90% of a state government's GHG emissions (Massachusetts, 2004).
- *Increased asset value*. Improving energy efficiency can increase a building's lifetime and overall value. EPA estimates that for every $1

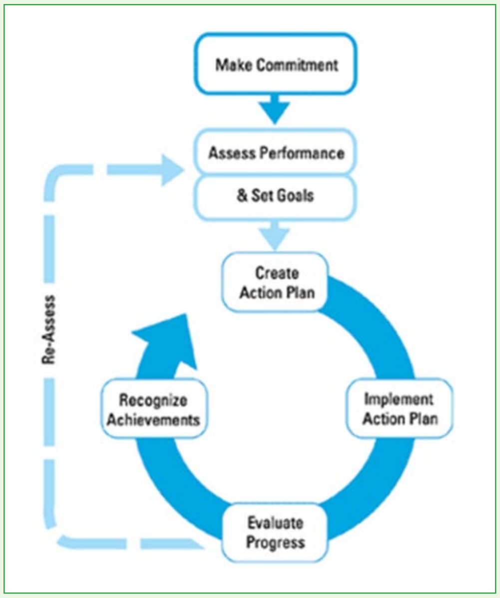


FIGURE 2.1.1 OVERVIEW OF ENERGY STAR GUIDELINES FOR ENERGY MANAGEMENT

The ENERGY STAR *Guidelines for Energy Management* present a seven-step approach to achieving superior energy management and savings across a portfolio of buildings. The steps include:

1. Make Commitment
   - Establish an Energy Team
   - Institute an Energy Policy
2. Assess Performance
   - Collect and Manage Data
   - Establish Baselines and Benchmark
   - Analyze Data and Conduct Technical Assessments and Audits
3. Set Goals
   - Estimate Potential for Improvement
   - Establish Goals
4. Create Action Plan
   - Define Technical Measures and Targets for Each Building
   - Determine Roles and Resources
5. Implement Action Plan
   - Create a Communication Plan, Raise Awareness and Build Capacity
   - Track and Monitor Progress
6. Evaluate Progress
   - Measure Results
   - Review Action Plan
7. Recognize Achievements
   - Internal Recognition
   - External Recognition

For detailed descriptions of the above steps, see *http://www.energystar.gov/index.cfm?c=guidelines.guidelines_index*. (U.S. EPA. 2008e)

spent on energy efficiency improvements, a building's value increases by $2 to $3 (U.S. EPA, 2004).

- *Increased economic benefits through job creation and market development*. Investing in energy efficiency can stimulate the local economy and encourage development of energy efficiency service markets. According to DOE, approximately 60% of energy efficiency investments goes to labor costs and half of all energy-efficient equipment is purchased from local suppliers (U.S. DOE, 2004). Across the nation, energy efficiency technologies and services are estimated to have created more than eight million jobs in 2006 (ASES, 2007).

- *Other*. Other benefits from improving energy efficiency in state government facilities include reduced summer peak energy demand and improved indoor air quality and productivity for occupants (U.S. EPA, 2003; U.S. EPA, 2006b).

2.1.2 PLANNING AND IMPLEMENTATION STRATEGIES FOR IMPROVING ENERGY EFFICIENCY IN GOVERNMENT BUILDINGS

The most cost-effective approach for meeting a state government's building energy needs is to engage in a systematic process for improving energy efficiency in portfolios of owned and leased building space and to design energy efficient new and renovated buildings. A portfolio-wide approach results in greater total reductions in state government energy costs and GHG emissions and enables states to offset the costs of more substantial energy efficiency projects in buildings that have higher up-front costs with the savings from projects in other buildings. In addition, adopting a portfolio-wide approach can help states generate greater momentum for energy efficiency activities, leading to sustained implementation and continued savings.

However, in cases where resources for portfolio-wide improvements are not available, this process can be applied to one or a few government buildings. Experiences from such demonstration projects can then be used to make the case for further energy efficiency improvements in buildings and subsequently can be applied to the broader buildings portfolio when additional support and/or resources become available.

A systematic approach to adopting an energy management strategy has been developed under EPA's ENERGY STAR program, and is summarized in the *Guidelines for Energy Management* and in Figure 2.1.1, *Overview of ENERGY STAR Guidelines for Energy*

Management. The *Guidelines for Energy Management* present the following seven-step approach to achieving superior energy management and savings in buildings:

- Step 1. Make Commitment
- Step 2. Assess Performance
- Step 3. Set Goals
- Step 4. Create Action Plan
- Step 5. Implement Action Plan
- Step 6. Evaluate Progress
- Step 7. Recognize Achievements

These steps for improving building-level energy management are similar to the steps for developing a comprehensive LBE program. Given the significant potential benefits that implementing energy efficiency in buildings can have, especially with respect to reductions in energy costs and GHG emissions, this section of the *LBE Guide* describes the steps of the ENERGY STAR *Guidelines for Energy Management* in detail, and identifies where these steps coincide with the steps for developing a comprehensive LBE program. When developing their LBE programs, states can identify opportunities to incorporate information provided in the *Guidelines for Energy Management*, which will ensure that LBE programs lead to superior energy management in state government buildings.

TABLE 2.1.1 ENERGY STAR PROGRAM RESOURCES

Title/Description	Web Site
ENERGY STAR Tools and Guidance for Existing and New Buildings	
Guidelines for Energy Management. EPA provides the seven-step Guidelines for Energy Management to assist in developing and implementing energy efficiency action plans.	*http://www.energystar.gov/index.cfm?c = guidelines.guidelines_index*
Guidelines for Energy Management Assessment Matrices. EPA has developed an assessment matrix to help energy managers determine if their organization's energy management practices are consistent with the Guidelines for Energy Management. A second matrix allows energy managers to compare current energy management practices to the Guidelines for Energy Management at the site-specific facility level.	*http://www.energystar.gov/ia/business/guidelines/assessment_matrix.xls* *http://www.energystar.gov/ia/business/guidelines/Facility_Energy_Assessment_Matrix.xls*
Portfolio Manager. Local governments can use the ENERGY STAR Portfolio Manager tool to measure and track the energy intensity of their buildings, normalized for weather and square footage. For certain building types, Portfolio Manager can be used to rate building performance on a scale of 1 to 100 relative to similar buildings nationwide, enabling facility managers to assess their own facilities and identify priority energy efficiency improvements.	*http://www.energystar.gov/index.cfm?c = evaluate_performance.bus_portfoliomanager*
ENERGY STAR Label. Buildings that achieve a rating of 75 or higher using Portfolio Manager, and are professionally verified to meet current indoor environment standards, are eligible to apply for the ENERGY STAR label. The ENERGY STAR label is available for office buildings, schools, hospitals, courthouses, and other facilities.	*http://www.energystar.gov/index.cfm?c = evaluate_performance.bus_portfoliomanager_intro*
Profiles of ENERGY STAR Labeled Buildings and Plants. EPA has compiled profiles of ENERGY STAR-labeled government buildings, accessible at its Web page, ENERGY STAR Labeled Buildings and Plants.	*http://www.energystar.gov/index.cfm?fuseaction = labeled_buildings.showBuildingSearch*
Building Upgrade Manual. The ENERGY STAR Building Upgrade Manual describes a five-step systematic approach to improving energy efficiency in existing buildings, including recommissioning/commissioning, lighting, supplemental load reductions, fan systems upgrades, and heating and cooling system upgrades.	*http://www.energystar.gov/index.cfm?c = business.bus_upgrade_manual*

TABLE 2.1.1 ENERGY STAR PROGRAM RESOURCES *(cont.)*

Title/Description	Web Site
Target Finder. Target Finder lets a user establish an energy performance target for a design project or major building renovation based on similar building types and desired energy performance. By entering the project's estimated energy consumption, users can then compare the estimated energy use with the target to see if the project will achieve its goal.	*http://www.energystar.gov/index.cfm?c = new_bldg_design.bus_target_finder*
"Designed to Earn the Energy Star" Label. Building designs that achieve a rating of 75 or higher using the ENERGY STAR Target Finder tool are eligible to receive the "Designed to Earn the ENERGY STAR" designation. These buildings can apply for the ENERGY STAR label if they remain in the top quarter of the rating scale after one year of operation.	*http://www.energystar.gov/index.cfm?c = new_bldg_design.new_bldg_design_benefits*
Target Finder Opportunities Flowchart. A flow chart detailing opportunities to use Target Finder to assess projected design performance is available at:	*http://www.energystar.gov/ia/business/tools_resources/new_bldg_design/Design_process_flow_diagram_101404.pdf*
Integrated Energy Design Guidance. EPA provides guidance on planning and designing buildings that integrate energy efficiency improvements. This guidance includes information on how to use tools such as Target Finder to design buildings that achieve energy performance goals.	*https://www.energystar.gov/index.cfm?c = new_bldg_design.new_bldg_design_guidance*
Integrated Energy Design Guidance Checklist. A checklist that highlights components in the design process that can lead to ENERGY STAR labeling is available at:	*http://www.energystar.gov/ia/business/tools_resources/new_bldg_design/BuildingDesignGuidanceChecklist_101904.pdf*
ENERGY STAR Financial Calculators	
Cash Flow Opportunity Calculator. This tool can be used to: determine how much new energy-efficient equipment can be purchased based on estimated cost savings; determine whether equipment should be purchased now using financing, or if it is better to wait and use cash from a future year's budget; and determine whether money is being lost by waiting for lower interest rates.	*http://www.energystar.gov/index.cfm?c = assess_value.financial_tools*
Financial Value Calculator. This tool presents energy efficiency investment opportunities in terms of key financial metrics. It can be used to determine how energy efficiency improvements can affect organizational profit margins and returns on investments.	*http://www.energystar.gov/index.cfm?c = assess_value.financial_tools*
Building Upgrade Value Calculator. This calculator can be used to estimate the financial benefits of improving energy efficiency in office buildings.	*http://www.energystar.gov/index.cfm?c = assess_value.financial_tools*
Additional ENERGY STAR Resources and Tools	
ENERGY STAR for Government. This Web site provides resources for state and local governments to use as they plan energy efficiency activities, including energy management guidelines, information on financing options, and tools and resources to measure and track energy use.	*http://www.energystar.gov/index.cfm?c = government.bus_government*
The ENERGY STAR Challenge. The ENERGY STAR Challenge — Build a Better World 10% at a Time program calls on governments, schools, and businesses across the country to identify energy efficiency improvements in their facilities and improve energy efficiency by 10% or more. EPA estimates that if each building owner accepts this challenge, by 2015 Americans would save about $10 billion and reduce GHG emissions by more than 20 million metric tons of carbon equivalent — equivalent to the emissions from 15 million vehicles.	*http://www.energystar.gov/index.cfm?c = challenge.bus_challenge*
ENERGY STAR Free Online Training. ENERGY STAR offers free online training sessions on a variety of energy performance topics.	*http://www.energystar.gov/index.cfm?c = business.bus_internet_presentations*
Off the Charts. Off the Charts is EPA's ENERGY STAR e-newsletter on energy management developments and activities.	*http://www.energystar.gov/ia/business/guidelines/assess_value/Off_the_Charts_Summer_2007.pdf*

The following sections provide information on key policy and implementation strategies for each of the *Guidelines for Energy Management* steps. Table 2.1.1, *ENERGY STAR Program Resources*, summarizes the many tools and resources available to states as they plan and implement energy efficiency improvements in their government buildings.

Step 1: Make Commitment

Committing to improving energy efficiency in a specified portfolio of buildings is an important first step for ensuring success. This step involves 1) identifying a team of qualified personnel to further develop the policy, with team members responsible for coordinating activities, securing funding, and regularly assessing progress, among other things, and 2) establishing and committing to an energy policy to improve energy efficiency in buildings. Successful state efforts also frequently involve securing a commitment from the governor's office.

These actions can be implemented as part of the larger LBE program: for example, the "energy efficiency in buildings" team can be a part of, or work with, the broader LBE team, and promoting energy efficiency in buildings can be a component of a broader LBE program. For more information on selecting members for a team to develop this policy, see Section 3.1, *Select an LBE Team*.[2] For more information on establishing an energy policy, see Section 3.4, *Set LBE Goals*.

Many state governments have included in their energy policies a range of commitments to specific actions that can lead to easier and more effective implementation of an overall energy efficiency program. These commitments include:

- *Use life-cycle cost analysis*. Because state governments are concerned with long-term – as well as short-term – benefits and costs, they are well-positioned to adopt life-cycle cost analyses when making decisions about purchasing energy-using products. Traditional methods for assessing project cost-effectiveness typically focus on the initial design and construction costs. The life-cycle cost of a product or service is the sum of the present values of the costs of investment, capital, installation, energy, operation, maintenance, and disposal over the life of the product (U.S. DOE, 2003). Because life-cycle cost analysis accounts for the lower energy costs that can result from a somewhat larger initial investment, it can be an important feature of an overall energy policy. Many states use life-cycle cost analyses to identify energy-efficient products that have shorter payback periods, typically less than five years. More information on life-cycle costing is provided in Section 5.2, *Fund the LBE Program*.

- *Purchase energy-efficient products*. Committing to purchasing energy-efficient products is key to improving energy efficiency across a portfolio of buildings. Purchasing energy-efficient products can make comprehensive energy efficiency upgrades more cost-effective by reducing building energy loads, typically by as much as 5% to 10% (LBNL, 2002). Some state and local governments are making a procurement policy for efficient products an explicit part of their building energy efficiency policy. More information on energy-efficient product procurement is provided in Section 2.3, *Energy-Efficient Product Procurement*.

- *Ensure energy efficiency is a key component of green building strategies*. Energy efficiency can be integrated with other green buildings measures to achieve additional energy, environmental, indoor air quality, and water savings benefits. Designing for superior energy

[2] *Section 3.2, Identify and Obtain High-Level Support, presents suggestions for how to obtain the governor's support or other high-level backing for an LBE program.*

VIRGINIA ENERGY EFFICIENCY POLICY AND ADVISORY COUNCIL

In 2007, the governor of Virginia issued an executive order committing the state government to improve energy efficiency in its facilities and operations and setting a goal for executive branch agencies and institutions to reduce the annual cost of non-renewable energy purchases by at least 20 percent of fiscal year 2006 expenditures by fiscal year 2010. To meet this goal, the state adopted a policy directing state agencies and institutions to pursue a number of activities, including:

- Design all new and renovated state-owned facilities to meet energy performance standards at least as stringent as those prescribed by ENERGY STAR or the LEED rating system.
- When leasing facilities for state use, give preference to buildings that meet ENERGY STAR or LEED standards.
- Identify performance contracting opportunities.
- Purchase ENERGY STAR-qualified equipment and supplies.
- Implement all possible low-cost energy-saving activities (i.e., with payback periods of one year or less).
- Pursue alternate energy procurement options.

To provide guidance in implementing this policy, the executive order created an Energy Policy Advisory Council, led by a Senior Advisory for Energy Policy.

Source: Virginia, 2007.

management is often the first step in green building, and can improve environmental performance and overall cost-effectiveness of a green building strategy (U.S. EPA, 2003; U.S. EPA, 2006c). More information on developing green building policies is provided in Section 2.2, *Energy Efficiency in Green Buildings*.

- *Coordinate energy efficiency in buildings with climate change goals*. Many state and local governments are taking active roles in developing climate policy by committing to reduce GHG emissions. Incorporating energy efficiency activities into their climate policies can help governments meet their GHG emission reduction commitments. In addition, by making the link between climate change and energy efficiency, states are in a better position to gain support for both programs.

Steps 2 and 3: Assess Baseline Energy Performance and Set Goals

After making a commitment, the next two steps to improve energy efficiency across a portfolio of buildings are to assess baseline energy performance and set goals. Assessing energy performance involves looking at how energy is used in existing buildings and identifying opportunities to improve energy efficiency. Setting goals involves looking at potential savings in new and renovated buildings as well as existing ones.

Understanding improvements in energy performance involves periodically comparing a building's energy usage to its baseline energy use (established at a specified time in the past). This is a key step in establishing an effective strategy to improve energy efficiency in buildings and set goals for future energy performance. Key approaches for assessing baseline building energy performance in existing buildings include:

- *Use available, standardized tools for baseline energy use assessments*. Standardized tools can be used to help assess baseline energy use and track building energy data. For example, EPA's ENERGY STAR Portfolio Manager is an on-line tool that can be used to assess baseline energy performance in existing buildings and compile data across a portfolio of buildings (U.S. EPA, 2008m).

- *Benchmark buildings*. Benchmarking involves comparing a building's energy performance to the performance of similar buildings across the county. For certain building types, EPA provides an energy performance rating in Portfolio Manager to compare buildings against similar buildings nationwide on a scale of 1 to 100. For example, a rating of 75 means that the evaluated building performs better than 75% of similar buildings nationwide. This information can help states prioritize which buildings to target for their energy efficiency investments and/or to be the focus of a comprehensive energy audit strategy (see the next bullet, below).

- *Conduct technical assessments and audits*. In addition to establishing baseline energy performance and determining a building's relative performance compared to its peers, a thorough energy performance assessment includes comparing the actual performance of a building's systems and equipment with their designed performance level or the performance level of top-performing technologies. These technical assessments can be conducted as part of a whole-building energy audit conducted by an energy professional and used to identify potential energy-saving opportunities. Many states have incorporated these energy audits into energy performance contracts, which are contracts that offer a one-stop process for purchasing, installing, maintaining,

LOCAL AND STATE ASSOCIATIONS - INTEGRATING ENERGY EFFICIENCY AND CLIMATE CHANGE

The U.S. Conference of Mayors (USCM), the National Association of Counties (NACo), and the National Governors Association (NGA) are promoting actions that link the need for global climate protection with energy efficiency (e.g., via building standards and practices). For example:

USCM and NACo passed resolutions supporting EPA's ENERGY STAR Challenge to reduce energy consumption in public and private buildings by 10% or more. They promote ENERGY STAR tools and resources to members working to meet their climate protection and energy efficiency goals.

The USCM Climate Protection Agreement commits mayors to reduce GHG emissions in their cities to at least 7% below 1990 levels by 2012. The Climate Protection Center provides guidance to mayors on leading their cities' efforts to reduce GHG emissions linked to climate change, and publishes best practices, including examples of cities that are taking the lead in this effort by improving energy efficiency in their buildings and operations.

NACo launched the Green Government Initiative to provide resources for local governments on sustainability issues, including energy efficiency and air quality. NACo's Climate Protection Program provides counties with best practices, tools, and resources on developing and implementing climate change programs.

The NGA recently launched an initiative – Securing a Clean Energy Future – to enlist governors' support in reducing the impacts of climate change through energy efficiency, clean technology, energy research, and deployment of alternative fuels.

Sources: NACo, 2002, 2005, 2005a; NGA, 2008; USCM, 2006, 2007, and 2008.

and often financing energy-efficiency upgrades at no up front cost. EPA has developed a directory of energy professionals, energy service companies (ESCOs), and other companies that can provide states with expert advice and technical assistance on conducting energy audits and entering energy performance contracts.[3] For more information on energy performance contracting, see Section 5.2, *Fund the LBE Program*.

State governments can establish specific energy efficiency goals for existing and new buildings to help maintain momentum for energy management activities and to guide daily decision-making. Setting clear and measurable goals is also critical for tracking and measuring progress. Goals for existing buildings can be based on the results of the baseline energy performance assessment, while goals for new buildings can be based on the output of energy performance projection tools and best practices. Key considerations for setting goals for improving energy efficiency in existing and new buildings include:

- *Consider potential savings*. As described above, states can use information collected during energy performance assessments and technical audits to determine potential energy savings and set appropriate goals for improving energy efficiency in existing buildings. States can also evaluate a building's benchmarking results to estimate potential savings based on the energy performance of similar buildings. For new and renovated buildings, state governments can use tools such as the ENERGY STAR Target Finder to set energy performance targets and assess building designs. In addition, states can consider the targets achieved by similar buildings by reviewing other organizations' and governments' experiences. Through July 2008, 31 states have accepted the ENERGY STAR Challenge, establishing goals of improving energy efficiency in their buildings by at least 10% (U.S. EPA, 2008w).

- *Determine appropriate scope*. Goals for improving energy efficiency in new and existing buildings can be established at different levels, ranging from process- or equipment-specific goals, to facility-level and portfolio-wide goals. These goals can also be established over varying time periods. Many states have established both short-term and long-term goals for improving energy efficiency in buildings that can lead to quick cost savings that continue to accrue far into the future.

[3] See http://www.energystar.gov/index.cfm?c = spp_res.pt_spps for a directory of energy service and product providers.

Goals for improving energy efficiency in state buildings can be part of a larger LBE goal that incorporates multiple clean energy LBE activities. For more information on setting LBE goals, see Section 3.4, *Set LBE Goals*.

Steps 4 and 5: Create and Implement An Action Plan

A regularly updated action plan for improving energy efficiency in existing and new buildings can serve as a

STATE AND LOCAL GOVERNMENTS USING ENERGY STAR TO MEET ENERGY SAVINGS GOALS

Many state and local governments are using ENERGY STAR to meet their energy savings goals.

- About two-thirds of the nation's states, and more than 200 local governments, have adopted the ENERGY STAR Challenge to improve energy efficiency in their buildings by at least 10% (U.S. EPA, 2008o).
- Some states, such as California and Hawaii, have directed state agencies to give priority to ENERGY STAR-labeled buildings when pursuing new leases (California, 2004a; Hawaii, 2006).
- Minnesota has established a goal for the state to achieve 1,000 ENERGY STAR-labeled commercial buildings, including state government facilities, by 2010 (Minnesota, 2007).
- New Hampshire has entered the ENERGY STAR Challenge, through which participants commit to reduce energy use by 10% (U.S. EPA, 2005c).

BENCHMARKING STATE FACILITIES IN CALIFORNIA

California Executive Order S-20-04, issued in 2004, established a number of energy efficiency goals for public and commercial facilities, including state government buildings and schools. Among these goals was a directive to state agencies to reduce grid-based energy purchases for state-owned buildings by 20% by 2015 from 2003 levels.

An *Green Building Action Plan* that accompanied the executive order directed the California Energy Commission (CEC) to coordinate with EPA to develop a system to benchmark and track energy consumption in state facilities. The CEC developed a system based on the ENERGY STAR Portfolio Manager tool and tailored to California's unique needs. In August 2008, the state reported that it had benchmarked more than 100 million square feet of its facilities, which revealed a 4% decrease in energy consumption in state facilities since 2003.

In addition, a bill passed by the state legislature in 2007 will make it easier for state agencies to update energy consumption data for benchmarked facilities. Assembly Bill 1103 requires electric and gas utilities in the state to maintain at least 12 months of data for all non-residential buildings to which they provide services, beginning in 2009. This data must be maintained such that it can be uploaded into Portfolio Manager at the building owner's request.

Sources: California, 2004a; California, 2004b; California, 2007; California GAT, 2008.

roadmap for implementing energy efficiency measures through a systematic process. Step 4, creating an action plan involves establishing energy performance targets for each building, identifying the technical measures that can help meet that performance target, identifying resources necessary to implement the action plan, and determining roles and responsibilities of internal and external parties.

Key strategies for developing an action plan for improving energy efficiency in buildings include:

- *Develop whole building energy performance targets.* Once a state government has evaluated its portfolio's performance and set portfolio-wide goals (based on the energy savings potential of priority investments in existing buildings and the anticipated energy savings potential for new building designs), it can establish energy performance targets for each existing and new building. Establishing energy performance targets for each building allows states to clearly articulate to building occupants and other key personnel the expected results of energy efficiency investments in each facility, and enables state governments to track progress and measure results. Whole building energy performance targets can be developed for existing buildings using the ENERGY STAR Portfolio Manager tool, which enables users to identify baseline energy performance and set targets based on EPA's national energy performance rating system (U.S. EPA, 2008m). For new buildings, a complementary tool called the ENERGY STAR Target Finder can be used to set whole building performance targets (U.S. EPA, 2008c). For building types not covered by these tools, EPA has developed a list of reference energy performance targets based on national averages.[4]

- *Use a staged approach to identify technical measures for improving energy efficiency*. For *existing* buildings, a staged approach, which sequences building upgrades in a logical, systems-oriented way, can lead to the greatest energy savings for the available budget. When following this approach, states can identify, for each step in the process, appropriate technical measures that are most likely to improve energy efficiency in a cost-effective way. The staged approach recommended by EPA's ENERGY STAR program involves implementing the following steps in sequence (see the text box on page 2-15 for a more detailed description of this approach):
  - Conduct recommissioning.
  - Install energy-efficient lighting.
  - Purchase ENERGY STAR-labeled office equipment and building envelope components to reduce the supplemental load.
  - Install fan system upgrades.
  - Install heating and cooling system upgrades.

Figure 2.1.1 illustrates the benefits of implementing energy efficiency upgrades based on several of these EPA-recommended stages. As shown in the figure, cooling capacity can be reduced by up to 5% for a typical office building when implementing HVAC measures *after* all other upgrades. The figure also shows that implementing upgrades in appropriate stages reduces the overall cooling capacity needed, which can enable state governments to purchase "right-sized" equipment. "Right-sized" equipment is sized to meet the necessary load after efficiency measures are implemented, as opposed to oversized equipment that serves the load, but at a higher up-front cost.

Figure 2.1.2 illustrates how implementing upgrades in a staged fashion can reduce a building's energy loads,

[4] *See 2003 CBECS National Average Source Energy Use and Performance Comparisons by Building Type (http://www.energystar.gov/ia/business/tools_resources/new_bldg_design/2003_CBECSPerformanceTargetsTable.pdf) for a list of reference energy performance targets for building types not currently eligible to receive ratings under EPA's building energy performance rating system.*

FIGURE 2.1.1. BENEFITS OF INTEGRATING ENERGY EFFICIENCY MEASURES

Sequence of Upgrade Measures	1st Upgrade	2nd Upgrade	3rd Upgrade	Cooling Capacity (Tons)	Reduction in Cooling Capacity (%)
Good	HVAC	O&M	Lighting	760	0%
Better	O&M	HVAC	Lighting	752	1%
Best	O&M	Lighting	HVAC	722	5%

Source: NAPEE, 2008.

and result in an overall energy consumption reduction of 30% (NAPEE, 2008).

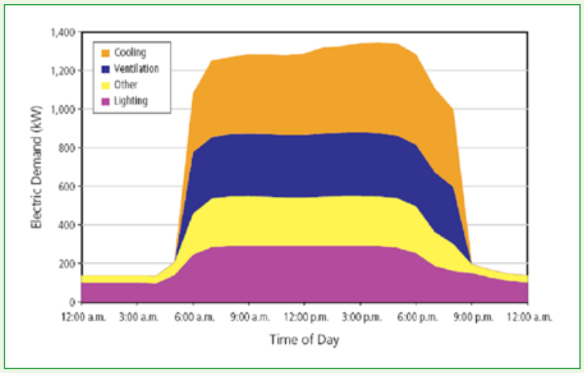
While the preceding staged approach makes sense for existing buildings, states follow a different approach for *new* buildings. To help states design new building systems and materials as an integral network that will improve energy performance, EPA has developed the ENERGY STAR *Integrated Energy Design Guidance to Design* (U.S. EPA, 2008b). This guidance document can help states identify cost-effective energy measures that consider the environment, climate, building orientation, and other features that affect performance in new facilities. It is important to note that for new buildings, it is essential to conduct commissioning during the construction process and to continue commissioning through occupancy to verify that the new building functions as intended. Several resources are available to help states identify energy efficiency measures for existing buildings and new buildings, including:

- *Upgrade and design guidance materials*. Energy efficiency upgrade and design guidance materials are helpful for identifying and prioritizing technical measures to incorporate into a state's energy efficiency action plan. For example, the ENERGY STAR *Building Upgrade Manual* provides guidance on using the staged approach for upgrading existing buildings (see the text box on page 2-15). For new buildings, states can use energy-efficient design guidelines such as the ENERGY STAR *Integrated Energy Design Guidance*. This document provides a strategic management approach for incorporating energy performance considerations into the building design process, and can be used by design professionals to establish and achieve energy performance goals (U.S. EPA, 2008b). States can also use the *Whole Building Design Guide*, a resource developed with EPA and DOE support by the National Institute of Building Sciences, which provides information on energy-efficient building design and offers numerous case studies, tools, and guidance documents (WBDG, 2008).

- *Best practices*. States can obtain information on best practices from other organizations that have upgraded buildings and achieved superior energy performance. For example, *ENERGY STAR Labeled Buildings and Plants* is an EPA-maintained list of the more than 4,000 buildings that have earned the ENERGY STAR label for energy performance (U.S. EPA, 2008r).

FIGURE 6.1.3 TYPICAL OFFICE BUILDING LOAD PROFILE

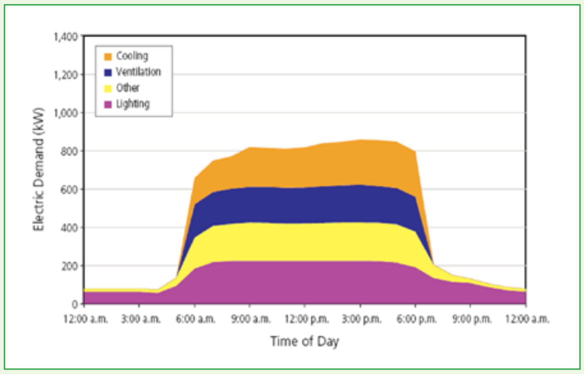
The graphic below illustrates a typical 250,000 ft^2 office building's load profile for cooling, ventilation, lighting, and other energy demand on a summer day in Chicago, Illinois.



Implementing a suite of energy efficiency upgrades could significantly reduce the building's energy consumption. The graphic below illustrates the energy loads for the same building after implementing several staged upgrades, including:

1. O&M/re-commissioning measures (e.g., optimizing temperature setpoints, HVAC scheduling, etc.)
2. Lighting measures (compact fluorescents, daylighting controls, etc.), and
3. HVAC measures (high efficiency chillers, premium efficiency motors, etc.).

Implementing these upgrades noticeably reduces each energy load. The total resultant energy decrease is approximately 30%.



Source: NAPEE, 2008

Many ESCOs have experience with proven technical energy efficiency measures, and can incorporate these measures into an action plan through the energy performance contracting process. EPA has developed a directory of service product providers that can provide states with expert advise and technical assistance on entering energy performance contracts.[5] For more information on energy performance contracting, see Section 5.2, *Fund the LBE Program*.

- *Secure necessary funding*. When creating an action plan for improving energy efficiency in state buildings, it is important to identify the capital costs of implementing the action plan, and to evaluate funding opportunities. The following financial tools are available through EPA's ENERGY STAR program to help prioritize energy efficiency investments and make the case for these investments:

  - *Cash Flow Opportunity Calculator*. This tool can be used to determine how much new energy-efficient equipment can be purchased based on estimated cost savings, whether equipment should be purchased now using financing or if it is better to wait and use cash from a future year's budget, and whether money is being lost by waiting for lower interest rates.

  - *Financial Value Calculator*. This tool presents energy efficiency investment opportunities in terms of key financial metrics. It can be used to determine how energy efficiency improvements can affect organizational profit margins and returns on investments.

  - *Building Upgrade Value Calculator*. This calculator can be used to estimate the financial benefits of improving energy efficiency in office buildings.

Once a state government has determined the size of the investment required to implement priority energy efficiency upgrades, it can consider a range of financing options. Financial assistance for improving energy efficiency in state buildings can be secured through a number of sources. Many states administer programs that provide incentives to state departments or agencies that invest in energy efficiency, while a number of states have identified and secured funding resources from external sources. Energy performance contracts, for example, can be used to implement energy efficiency upgrades at no up-front cost, often through a financial arrangement with an ESCO. For more information on funding LBE programs, see Section 5.2, *Finance the LBE Program*.

In cases where states do not have sufficient resources to improve energy efficiency across a broad portfolio of buildings, they can concentrate resources to systematically improve energy efficiency in one or a few buildings. Experiences from such pilot projects can be applied to a broader suite of buildings when additional resources become available.

CASH FLOW OPPORTUNITY CALCULATOR

The ENERGY STAR Cash Flow Opportunity Calculator is a decision-making tool that can be used to influence the timing of energy-efficient product purchases. The tool can be used to determine:

- The quantity of energy-efficient equipment that can be purchased and financed using anticipated savings;
- Whether it is most cost-effective for the purchase to be financed now, or to be paid for using future operating funds; and
- The cost of delay: whether money is being lost while waiting for a lower interest rate.

www.energystar.gov/ia/business/cfo_calculator.xls

Source: U.S. EPA, 2003c.

Steps 6 and 7: Evaluate Progress and Recognize Success

Implementing an action plan for improving energy efficiency does not in itself guarantee that a building will achieve its intended energy performance target. State governments can verify that they are making progress toward achieving their overall energy efficiency goal by using tools such as the ENERGY STAR Portfolio Manager to monitor energy performance and identify new opportunities for energy efficiency improvements across their portfolio (Step 6, Evaluate Progress). Chapter 6, *Track, Evaluate, and Report on Progress*, provides additional guidance on options for evaluating the performance of an LBE program, including information specific to tracking and evaluating energy performance in government buildings.

Another way to sustain momentum and support for energy efficiency activities is to obtain recognition for achieving performance goals (Step 7, Recognize Success). In addition to recognizing success internally, third-party recognition opportunities include:

[5] *See http://www.energystar.gov/index.cfm?c = spp_res.pt_spps for a directory of energy service and product providers.*

OVERVIEW OF EPA BUILDING UPGRADE MANUAL STAGED APPROACH FOR IMPROVING ENERGY PERFORMANCE

The staged approach outlined in the 2008 *ENERGY STAR Building Upgrade Manual* provides a systematic method for planning energy efficiency upgrades in buildings that accounts for interactions between building energy systems, enabling organizations to achieve greater energy savings. This approach involves the following stages:

1. Commissioning and Recommissioning: Commissioning a new building before it becomes operational to ensure energy systems were constructed as designed can produce energy cost savings of $0.02 to $0.19 per square foot (Mills et al., 2004). Commissioning can also produce non-energy benefits, such as improved occupant comfort and indoor air quality. One study estimates that the average value of non-energy benefits for every $1 spent on commissioning ranges from $1 to as high as $2.30, when accounting for energy efficiency rebates. Non-energy benefits resulting from commissioning are estimated to be $0.50 per square foot (Mills et al., 2004; Jennings and Skumatz, 2006).

Recommissioning is a key activity in identifying technical measures for a staged approach to improving energy efficiency and involves periodically examining building equipment, systems, and maintenance procedures and comparing them to initial design intentions and current operational needs. This process can identify no- and low-cost technical measures for improving energy efficiency and can result in energy cost savings between $0.11 and $0.72 per square foot.

2. Lighting: Improving the energy efficiency of the building lighting system can reduce lighting energy costs. Lighting systems can account for up to 30% of a building's total energy use, and savings from going beyond standard equipment selection can be significant: 20% to 40% for lamps and ballasts, 30% to 50% for new fixtures, 40% to 60% for using task/ambient lighting strategies, and 30% to 50% for outdoor lighting. Improving lighting system energy efficiency can also improve lighting quality and reduce unwanted heat gain. Technical measures for improving lighting system energy efficiency include:

- Design light quantity and quality to meet task and occupant needs
- Maximize lamp and ballast efficiency
- Install automatic controls to turn off or dim lighting
- Establish schedules for group re-lamping and fixture cleaning
- Purchase ENERGY STAR-qualified lighting products
- Use responsible disposal practices.

3. Supplemental Load Reductions: Purchasing ENERGY STAR labeled office equipment and improving the energy efficiency of building envelope components (e.g., installing window films and adding insulation or reflective roof coating) reduces supplemental load energy consumption. Reducing supplemental loads enables organizations to install smaller fan, heating, and cooling systems that cost less and use less energy.

4. Fan Systems Upgrades: Fan systems can account for as much as 11% of an office building's total energy use. Technical measures, such as properly sizing fan system equipment, installing variable speed drives, and converting to a variable-air-volume system, can significantly reduce fan system energy costs from 50% to 85%.

5. Heating And Cooling System Upgrades: Heating and cooling systems typically account for one-third of a building's energy use. Improving energy efficiency in these systems can produce significant savings. Cooling system energy savings can range from 15% to 33% for central chiller systems and 20% to 35% for unitary air conditioning systems. Heating system energy savings can range from 10% to 30% for systems that use boilers and 5% to 25% for systems that use furnaces. A strategy for improving heating and cooling system efficiency involves:

- Measure heating and cooling loads
- Right size heating and cooling systems
- Install energy-efficient chillers
- Upgrade other heating and cooling system components
- Install variable speed drives on pumps and cooling tower fans
- Optimize operations.

Source: U.S. EPA, 2008x.

- *ENERGY STAR Qualified Buildings*. Buildings achieving an energy performance rating of 75 or greater are eligible to apply for the ENERGY STAR label. Buildings that have earned the ENERGY STAR label use, on average, 40% less energy as compared to conventional buildings, (U.S. EPA, 2008h).
- *ENERGY STAR Awards*. EPA also provides recognition to organizations that meet important energy savings milestones, such as improvements of 10%, 20% and 30% relative to their initial baselines.

2.1.3 EXAMPLES OF STATE AND LOCAL ACTIVITIES FOR IMPROVING ENERGY EFFICIENCY IN BUILDINGS

State and local governments are using a variety of approaches to improve energy efficiency in individual buildings and in their portfolio of government facilities. The following examples provide brief descriptions of some of these approaches. Additional examples are provided in, Section 4.5, *State Examples of Screening LBE Activities and Measures*.

Energy Efficiency in Existing Buildings

Michigan – State Facility Energy Savings Plan

The Michigan Department of Management and Budget is working to implement an energy savings plan with the goal of reducing energy expenditures in department-managed facilities by 10% by 2009, based on 2002 levels. This plan, which involves coordinating with the Department of Labor and Economic Growth's Energy Office to benchmark state facilities using EPA's ENERGY STAR tools, is expected to save the state $1.6 million annually beginning in 2009. To help state agencies reduce energy use in their facilities, the Energy Office provides assistance in securing energy performance contracts. Since 1987, the state has invested $17 million in energy performance contracts that it estimates have generated more than $22 million (Michigan, DLEG, 2008 and Michigan, DLEG, 2008a).

For example, Lake Superior State University (LSSU), a small public university in Sault Ste Marie, Michigan, became an ENERGY STAR partner and contracted with an energy service provider to help measure, track, and benchmark its energy performance, develop and implement a plan to improve its facilities and operations, and educate its staff and the public about its ENERGY STAR program and achievements. This process identified 184 facility improvement measures providing total annual energy and operational savings of almost $430,000 with a payback of about 11 years. The improvements included lighting retrofits, mechanical retrofits, steam trap retrofits, roof and window replacements, water saving measurements, and other enhancements to the 42 building campus. (Michigan Energy Office, Undated).

Web site: ***http://www.michigan.gov/dleg/0,1607,7-154-25676_25689_33337-103911--,00.html***

Montana – 20 X 10 Initiative

Created by the governor in 2007, the 20 X 10 Initiative calls on executive branch agencies to reduce their energy consumption by 20% by 2010, based on 2007 levels. Agencies can achieve this goal following various paths, but the state encourages them to adopt an energy management strategy that first capitalizes on the savings provided by measures with short payback periods. Specifically, state agencies are encouraged conduct a comprehensive energy audit of their facilities, and then focus on improving the energy efficiency of their operating practices (e.g., making adjustments to lighting and heating settings) and purchasing ENERGY STAR-qualified equipment.

The state Department of Environmental Quality is collecting past energy bills and using these data to assess each agency's baseline energy performance. In addition, this database will be used to provide agencies with regular energy use reports so they can track their progress in reducing energy consumption. The state's executive branch agencies spent approximately $12 million on energy in its baseline year (2007), meaning the initiative could potentially save the state $2.4 million in 2010 (Montana, 2008).

Web site: ***http://governor.mt.gov/20x10/***

New Hampshire – ENERGY STAR Challenge Participant

In 2004, the governor of New Hampshire issued an executive order directing the Department of Administrative Services to develop an energy information system that state government agencies could use to track and report their energy use. In addition, the order requires agencies to train staff in using EPA's ENERGY STAR tools and to use these tools to benchmark state government facilities. It created an Energy Efficiency in State Government Steering Committee to develop plans to reduce energy use in state facilities, including a plan to conduct energy audits on all state facilities achieving scores between 40 and 60 on EPA's national energy performance rating system (using the ENERGY STAR benchmarking tools) and a plan to purchase ENERGY STAR-qualified products. The steering committee was also responsible for developing a state government-wide energy use reduction goal, which resulted in a 2005 executive order that entered the state as a participant in the ENERGY STAR Challenge, with the goal of improving state government energy efficiency by 10%. This second executive order also directs state agencies to implement the steering committee's plans for reducing energy use (New Hampshire, 2004; New Hampshire 2005).

In 2006, the renovated Department of Justice building became the first office building in the state to receive the ENERGY STAR label. The state has conducted an energy efficiency upgrade of the facility under a performance contract that enabled the state to pay for the upgrade using energy cost savings. The building received new lighting and lighting controls, an advanced energy management system, energy-efficient hot water pumps and air conditioners, and water-efficient plumbing fixtures. The upgrades resulted in a 37% reduction in energy consumption and annual energy cost savings of over $24,000. These energy savings translate to the avoidance of more than 900 metric tons of CO_2 emissions annually (New Hampshire, Undated).

Web site: ***http://www.des.state.nh.us/ard/climatechange/index.html#state***

Oregon – Building Commissioning Program

Under its Building Commissioning program, the Oregon Department of Energy provides technical assistance to managers of both public and private facilities. The state requires recommissioning or commissioning for specified energy-related projects funded through the state's Public Purpose Fund. These projects include HVAC and direct digital control projects exceeding $50,000, boiler and chiller projects exceeding $100,000, and other energy-related projects (e.g., lighting and lighting controls, building envelope) exceeding $150,000 (Oregon, 2006).

Recommissioning a newly-constructed school facility in the Silver Falls, Oregon School District revealed discrepancies in the installation and operation of the HVAC systems that were causing energy costs to exceed expected costs by 32%. The school district estimated that the recommissioning findings and corrective actions would save approximately $15,000 per year in energy costs and that the full cost of the process would be recouped in about five years (Oregon, 2004).

Web site: ***http://www.oregon.gov/ENERGY/CONS/BUS/comm/bldgcx.shtml***

Washington – Building Commissioning Program

The Washington General Administration (GA) operates a Building Commissioning Program to assist publicly-owned or -operated facilities in conducting building commissioning. The GA partners with these facilities and provides resources to help them build a commissioning team, negotiate the scope of work and commissioning cost, and ensure that both new and existing buildings are designed and operated so that the operational needs are met, the building performs efficiently, and building operators are trained (Washington, 2006).

In 2003, the energy management and control system of the Washington Department of Ecology headquarters facility, which was designed in 1993 to exceed state energy code by 30%, received a substantial upgrade. This involved multiple improvements to the building's ventilation systems, including a new digital control system, building pressure controls, CO_2 controls, outside airflow instrumentation, and interactive kiosks throughout the building to provide system feedback to occupants. Following these upgrades, the entire building was re-commissioned to ensure that all equipment was operating correctly. Once completed, these upgrades reduced the building's energy intensity to 54.6 kBtu per square foot, considerably lower than the average 82 kBtu per square foot intensity of conventional buildings. This achievement earned the building the ENERGY STAR label in 2005 (U.S. EPA, 2008f).

Web site: ***http://www.ga.wa.gov/EAS/bcx/index.html***

Wisconsin – Wisconsin Energy Initiative

As part of its Wisconsin Energy Initiative, the state has partnered with EPA's ENERGY STAR program to implement energy efficiency measures in existing and new state buildings. Beginning with a lighting retrofit, the state used ENERGY STAR tools and resources to systematically replace lighting fixtures in 53 million square feet of office space in state government buildings. The results of this initial measure were substantial: over 108 million kWh of annual energy savings, approximately $7.5 million in annual energy cost savings, and emission reductions equivalent to removing nearly 20,000 vehicles from state roads for one year.

The state followed this initial retrofit with whole-building examinations, pursuing new strategies for improving energy efficiency and reducing water usage. Under the expanded initiative, the state retrofitted an additional 60 million square feet of office space at a total expected cost for the upgrades of $35 million. The annual savings achieved as a result of these comprehensive assessments are expected to total $11 million. Projected additional energy and emissions savings are significant: 15.6 million kWh; 11,472 tons of carbon, 1,156 pounds of NO_x, and 537 pounds of CH_4 (NASEO, 2006).

Web site: ***http://www.naseo.org/tforces/energystar/casestudies/.***

Energy Efficiency in New Buildings

North Carolina – Sustainable Energy Efficient Buildings Program

North Carolina joined the ENERGY STAR Challenge in 2005 and is working with EPA'S ENERGY STAR program to improve its facilities' energy efficiency by 10%. In 2007, the state legislature passed a bill requiring that the combined energy consumption for all state government buildings be reduced by 20% by 2010, and 30% by 2015, based on FY 2004 levels. The 2007 legislation also created the *Sustainable Energy Efficient Buildings Program*. Under this program, all new buildings greater than 20,000 square feet, and renovated buildings greater than 20,000 square feet with renovation costs greater than 50% of the insurance value, must be designed, constructed, and certified to exceed the ASHRAE 90.1-2004 Standard by 30% (for new buildings) and 20% (for renovations), and must be commissioned to verify energy-efficient design. The bill includes a provision that after one year of operation, the new building energy performance must be verified. If at this time energy performance is 85% or less than the target, corrections and modifications must be explored (North Carolina, 2007; U.S. EPA, 2008q).

The *Sustainable Energy Efficient Buildings Program* is a component of the state's *Utility Savings Initiative*, a multi-program approach to reducing utility expenditures in state buildings that involves strategic energy planning, agency personnel training, and performance contracting.

Web sites: ***http://www.energync.net/programs/usi.html*** ***(Utility Savings Initiative)***

http://www.energync.net/programs/docs/usi/SessionLaw2007-546.pdf (Sustainable Energy Efficient Buildings Program Enabling Legislation)

Fort Collins, Colorado – Energy Management and Integrated Energy-Efficient Design in K-12 Schools

The Poudre School District in Fort Collins, Colorado began an energy management program in 1994 with a goal of reducing energy costs district-wide. As part of this program, the district has implemented nearly 150 energy efficiency upgrades through 2007, producing annual energy cost savings of nearly $440,000. To help evaluate and track district-wide energy performance, the district has used ENERGY STAR tools to benchmark each of its buildings.

As of FY 2007, 17 schools and two administrative offices had earned the ENERGY STAR label, including the new Operations Building. This building's design integrated a number of energy efficiency measures, including daylighting, automated lighting systems with dimmers, on-site solar electricity generating panels, and a geo-exchange heating system. To achieve optimum energy efficiency measure integration, the design team used EPA's ENERGY STAR Target Finder tool to set energy targets multiple times during the early stages of the building design process. These early evaluations allowed the design team to use Target Finder's energy simulation software to make adjustments to building orientation, envelope, materials, internal systems, and equipment. As the design process progressed, the team was able to achieve consistent design performance ratings in the 80s. The building was completed in 2002, and after 12 months of energy use data were compiled, the building earned a rating of 97 on the EPA national energy performance rating system, qualifying the building for the ENERGY STAR label. In 2005, the Operations Building achieved a perfect rating (U.S. EPA, 2008d).

Web site: ***http://www.psdschools.org/services/operations/facilities/energymanagement.aspx***

2.2 ENERGY MANAGEMENT IN GREEN BUILDINGS

Many states have found that the new and renovated building planning, design, and construction processes offer opportunities to integrate energy efficiency measures with other "green" features (e.g., lowering GHG emissions, improving indoor air quality and sustainable site selection) that provide additional environmental, economic, and health benefits. Energy efficiency, a critical element of green building that is often considered first in green building design, has become the cornerstone of many state government green building programs. In addition to enhancing a building's

GREEN BUILDING AND ENERGY STAR

When upgrading existing buildings or designing new buildings, states are looking to green building certification programs such as U.S. Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) design-based rating system and the Green Globes rating system. These rating systems standardize the elements of green building by conferring design certification based on requirements for (1) energy and atmosphere, (2) site sustainability, (3) water efficiency, (4) materials and resources, (5) indoor air quality, and (6) innovative design process.

Depending upon the rating system, it can be important to add requirements for energy performance, such as achieving EPA's ENERGY STAR program levels. It is also important to require third-party verification, which is required to earn the ENERGY STAR label on commercial buildings.

Some states and cities, such as Pennsylvania and Washington, D.C., have found that using a combination of ENERGY STAR and LEED is key to ensuring that new and renovated buildings meet both energy and environmental performance criteria.

environmental profile (e.g., through reduced GHG emissions), states have found that incorporating energy efficiency can improve the cost-effectiveness of green buildings.

Many terms are used to describe buildings that incorporate energy efficiency and other environmental features. These terms include *green buildings, high performance buildings*, and *sustainable buildings*, among others. There is not yet a consensus on the definitions of these terms, and energy and environmental experts sometimes use the terms interchangeably. Regardless of the definitions, there is often a public perception that energy efficiency and "green" are interchangeable, and that green buildings are energy efficient. However, this is not always the case; some "green" buildings do not adequately incorporate energy efficiency.

The *LBE Guide* uses the term "green building" as an all-encompassing description of buildings that incorporate *energy efficiency* plus other energy and environmental features where cost effective and practical, including:

- Renewable energy supply
- Combined heat and power (CHP)
- Sustainable site design that minimizes stress on the local landscape
- Water efficiency and quality
- Green materials and resources that minimize consumption and waste
- Indoor air quality

This section of the *LBE Guide* focuses on approaches for ensuring that green building policies and activities are designed to achieve energy efficiency and the associated environmental and financial benefits that come with combining superior energy performance and other green features.

2.2.1 BENEFITS OF GREEN BUILDINGS

Green buildings provide the benefits of energy efficiency (see Section 2.1.1.) plus additional energy and environmental benefits. For example, ENERGY STAR-labeled buildings can reduce energy costs by as much as 50% compared to conventional buildings, producing savings of about $0.50 per square foot per year. These energy efficiency savings are the key driver for achieving overall cost-effectiveness in green building design (U.S. EPA, 2008n; U.S. EPA, 2006l).

In addition, green buildings can provide environmental benefits, such as lowering GHG emissions, reducing construction and demolition debris, ecosystem protection, and conserving natural resources. The actual benefits depend upon the environmental features pursued by the building owner and developer, which can depend on the rating system adopted (e.g., LEED, Green Globe) and whether the building operates as designed.

Some of these environmental features can have secondary energy saving benefits. For example, many green buildings incorporate water efficiency measures, which can save heating energy while conserving a natural resource (U.S. EPA, 2008t). For more information on activities that can have secondary energy saving benefits, see Section 2.6, *Other Energy Saving Opportunities*.

2.2.2 PLANNING AND IMPLEMENTATION STRATEGIES FOR GREEN BUILDINGS

When planning and implementing strategies for green buildings, states can follow the energy management steps described in Section 2.1, *Energy Efficiency in Buildings*. Other key strategies include:

- *Ensure that energy efficiency is specifically included in green building policies*. Energy efficiency is a critical element of green building and is a key feature of the design process. States have found that requiring a

ARIZONA GREEN BUILDING POLICY

In 2007, Arizona passed legislation requiring the state's largest agencies to reduce energy consumption per square foot by 30% by July 1, 2020 based on FY 2002 levels. To help meet this goal, the legislation included a requirement that all new state-funded buildings be designed to meet LEED certification.

The new Arizona Department of Environmental Quality building was designed to achieve optimal energy performance with minimal impact on the environment. Using a 25-year lease-to-own financing agreement, the agency was able to use a life-cycle costing approach in designing the building. Building design energy efficiency and renewable energy measures include:

- A reflective roof to minimize "heat island effect"
- Variable frequency drives for motors
- Low-e glass to reduce reliance on cooling system
- Efficient lighting, including dimmers and LED exit signs
- Electrical system with ENERGY STAR transformers
- A 100-kW PV system connected to the grid.

The energy efficiency, renewable energy, and green measures incorporated into the building's design have earned it both LEED-Silver certification and the ENERGY STAR label.

Sources: ADEQ, 2006a, 2006b.

INCORPORATING ENERGY EFFICIENCY INTO GREEN BUILDING POLICIES

Energy efficiency can be incorporated into green building policies in different ways, depending on the green building rating system used. States can take the following steps to incorporate energy efficiency into green building policies.

LEED for Existing Buildings (LEED-EB)

- Require that the actual energy use of buildings meets aggressive energy performance targets, based on the most energy-efficient existing buildings in the market.
- For building types covered by EPA's ENERGY STAR Portfolio Manager rating system, the target should be at least 75, the level at which a building is eligible to earn the ENERGY STAR label. This is more stringent than the LEED-EB requirement and will result in greater energy efficiency. See *Develop Whole Building Performance Targets* in Section 2.1.2*, Planning and Implementation Strategies for Improving Energy Efficiency in Government Buildings*, for more detailed guidance and strategies for building types not covered by Portfolio Manager.
- Strive to achieve the greatest possible quantity of credits in the LEED energy and atmosphere section.
- Once a building has been operating for one year, compare the building's actual performance to the energy target used during the design phase and confirm that the building is eligible for the ENERGY STAR, where available.

LEED for New Construction (LEED-NC)

- Require design teams to meet an aggressive energy performance target, based on the most energy-efficient existing buildings in the market. For building types covered by EPA's ENERGY STAR Target Finder, the target should be at least 75, the level at which a building is "Designed to earn the ENERGY STAR." See *Develop Whole Building Performance Targets* in Section 2.1.2*, Planning and Implementation Issues for Improving Energy Efficiency in Government Buildings*, for more detailed guidance and strategies for building types not covered by Target Finder.
- Strive to achieve the greatest possible quantity of credits in the LEED energy and atmosphere section.
- Once a building has been operating for one year, compare the building's actual performance to the energy target used during the design phase and confirm that building is eligible for the ENERGY STAR, where available.

Green Globes Rating System for New Buildings or Significant Renovation

- Strive to achieve the highest possible rating using the Green Globes rating system, which requires new building designs to achieve a rating of 75 (to be eligible for the ENERGY STAR) or better using EPA's ENERGY STAR Target Finder. See *Develop Whole Building Performance Targets* in Section 2.1.2*, Planning and Implementation Issues for Improving Energy Efficiency in Government Buildings*, for more detailed guidance and strategies for building types not covered by Target Finder.
- Once a building has been operating for one year, compare the building's actual performance to the energy target used during the design phase and confirm that the building is eligible for the ENERGY STAR, where available.

combination of energy performance tools and green building approaches from the onset can ensure that new and renovated buildings meet both energy performance and environmental criteria. An increasingly common strategy is to use the EPA'S ENERGY STAR platform in conjunction with the USGBC's LEED rating system for green building design. For example, Pennsylvania is exploring the possibility of establishing a system that would mandate minimum point requirements in certain LEED categories in addition to requiring new state buildings to receive at least 85 points under ENERGY STAR certification (IEc, 2005). For more information on incorporating energy efficiency in green building polices, see the text box on page 2-24.

- *Evaluate opportunities for renewable energy sources*. While energy efficiency investments are typically a low-cost approach to reducing GHG and air pollution emissions in buildings, additional reductions can be achieved with on-site renewable energy sources (e.g., solar photovoltaics, geothermal heating). Green buildings that incorporate renewable energy generation as backup power systems can also benefit from improved power supply reliability. For more information about on-site renewable energy generation, see Section 2.5, *Clean Energy Supply*.
- *Integrate energy efficiency and renewable energy into climate change goals*. Implementing energy efficiency and renewable energy measures are key options for reducing GHG emissions. Thus, as governments adopt climate change goals, it is critical to develop a cost-effective and robust strategy for advancing clean energy within the government sector. By coordinating climate change, energy efficiency, and renewable energy activities, states are in a better position to achieve results and gain support for these programs.
- *Include requirements for third-party verification of energy performance*. Third-party verification is an important step towards ensuring that green buildings are energy efficient. While some green building certification only considers a building's design, third-party verification of energy performance can determine whether a building is performing as intended. States can obtain third-party verification from a number of sources, including ESCOs and energy service providers.[6]

A number of states have included provisions in their green building policies requiring third-party

[6] *See http://www.energystar.gov/index.cfm?c = spp_res.pt_spps for a directory of energy service and product providers.*

verification to confirm that, once they become operational, buildings meet the energy performance targets established during the planning and design phases. For example South Carolina established a goal to optimize energy performance in state buildings and pursue the ENERGY STAR label wherever possible. The legislation also includes a green building policy requiring all new state facilities to be designed to receive either the LEED-Silver certification or two globes using the Green Globes Rating System. The policy specifies that facilities designed to achieve these standards must earn at least 40% or 20%, respectively, of the available points for energy performance under the LEED and Green Globes rating systems. To ensure that new facilities achieve their intended energy performance, the legislation requires third-party verification in the fifth, tenth, and fifteenth years of operation. Commissioning agents must report on each building's energy performance relative to the performance anticipated during the design phase (South Carolina, 2007).

- *Consider conducting a demonstration project*. When resources and/or support for implementing a green building policy for state government facilities are limited, states can develop a single green building to serve as a demonstration project. These projects can be used to showcase the energy efficiency and environmental benefits of green buildings, while helping to make the case for implementing a portfolio-wide green building approach as additional support and/or resources become available.

2.2.3 EXAMPLES OF STATE AND LOCAL GREEN BUILDING ACTIVITIES

Many states and local governments have made green building activities the cornerstone of a comprehensive LBE program. Examples of state green building activities are provided below.

Hawaii – Lead by Example Initiative

The Hawaii Lead by Example Initiative began in 2006 with an executive order (later codified by the state legislature in Act 96) directing state agencies to improve energy, water, and resource efficiency in their facilities. The order established a green building policy, mandating that all state-funded newly constructed and renovated buildings be designed to meet LEED certification and achieve LEED-Silver certification where possible. To ensure that these buildings achieve superior energy performance, the state is following a strategic energy management approach that involves benchmarking, conducting whole-building energy audits, and recommissioning buildings in stages. In addition, a state energy coordinator is working to achieve energy performance certification for several state buildings through EPA's ENERGY STAR program. Through 2007, four state government buildings had earned the ENERGY STAR label (Hawaii, 2008).

In addition, the Hawaii Lead by Example Program is providing innovative solutions to the end-use efficiency strategy of the Hawaii Clean Energy Initiative (HCEI), a partnership established by the U.S. Department of Energy (DOE) and the State of Hawaii on January 28, 2008. The goal of the HCEI is to achieve a least a 70% clean energy basis for Hawaii within a generation.

Web site: ***http://hawaii.gov/dbedt/info/energy/efficiency/state/lbe***

Minnesota – State Sustainable Building Guidelines

The Minnesota Energy Security and Reliability Act of 2001 requires that new buildings receiving state bond funding be designed consistent with sustainable building design guidelines developed by the Departments of Administration and Commerce. The state legislature determined that these guidelines should require buildings to exceed existing energy codes by at least 30%. The resultant *State Sustainable Building Guidelines* are adapted from LEED rating system requirements (Minnesota, 2006). Preliminary analysis of three new state buildings constructed according to the guidelines indicated that the buildings' sustainable measures would result in a combined estimated reduction of more than 2.5 metric tons of air pollutants such as CO_2, NO_x, and SO_x (IEc, 2005; Minnesota PCA, 2006; Minnesota, 2001).

The guidelines are part of the broader statewide Buildings, Benchmarks, and Beyond (B3) project, through which the state is working with EPA's ENERGY STAR program to improve the energy efficiency of its own buildings and the buildings of the state's public school districts. The state government is a participant in the

MASSACHUSETTS GREEN BUILDING STANDARD

Massachusetts has adopted a green building standard for new buildings of 20,000 ft^2 or greater. This standard requires affected buildings to achieve basic LEED certification and meet a number of optional credits referenced in the LEED-New Construction rating system guidelines, including that energy performance must exceed Massachusetts Energy Code requirements by at least 20%.

Source: Massachusetts, 2007.

ENERGY STAR Challenge, with a goal of improving energy efficiency by 10% (U.S. EPA, 2008p) These LBE efforts will contribute to the governor's Next Generation Energy Initiative, issued in 2006, which sets a goal of 1,000 ENERGY STAR commercial buildings throughout the state by 2010 (Minnesota, 2006a) .

Web site: ***http://www.pca.state.mn.us/oea/greenbuilding/index.cfm.***

New Mexico – Lead by Example Initiative

In 2006, the governor of New Mexico issued an executive order that requires new and renovated public buildings to meet energy-efficient green building standards. The executive order requires adherence to the LEED-Silver standards in new and renovated public buildings that are greater than 15,000 square feet and/or use more than 50 kW peak electrical demand. These buildings, and smaller new and renovated buildings between 5,000 and 15,000 square feet, must also achieve a minimum energy performance standard of 50% of the average consumption for that building type.[7]

The 2006 building performance standards have become an essential component of the state's strategy for meeting the energy use reduction goal established by executive order in November 2007. This second order created the state government *Lead by Example Initiative* and directed all executive branch agencies to reduce energy use in state government buildings by 20% below 2005 levels by 2015. To ensure that the state's green buildings contribute to the energy goal, the state is developing a database to track government facility energy use. In addition, as a participant in the ENERGY STAR Challenge, the state is working with EPA's ENERGY STAR program to benchmark its facilities and train its facility managers to use ENERGY STAR tools, such as Portfolio Manager and Target Finder (U.S. EPA, 2008p; New Mexico, 2007; New Mexico, 2006).

Web site: ***http://www.emnrd.state.nm.us/ecmd/GovernmentLeadByExample/State-Government.htm***

New York – "Green and Clean" State Buildings

Executive Order 111, *"Green and Clean" State Buildings and Vehicles*, signed in 2001 and re-authorized in 2007, requires state agencies to follow LEED guidelines for the construction of green buildings and to strive to meet the ENERGY STAR building criteria for energy performance. Executive Order 111 also requires that all new buildings achieve at least a 20% improvement in performance relative to the State Energy Conservation Construction Code, and that all affected entities seek to ensure that 20% of their annual electricity needs in 2010 are met by renewable energy sources (NYSERDA, 2001). NYSERDA issued guidelines for government entities in developing implementation plans to meet the requirements of the order. Further guidance is offered through the state's Green Building Services program, which assists government agencies in design and LEED certification for new and renovated buildings (NYSERDA, 2004a).

NYSERDA has partnered with several state agencies to develop sustainable design guidelines for specific facility types within the state system, including *High-Performance Design Guidelines* for state college and university buildings and guidelines for Metropolitan Transportation Authority buildings (NYSERDA, 2005). The State University of New York at Binghamton constructed two buildings using these guidelines. Designed using green building design charrettes (i.e., collaborative brainstorming processes between the green building team members and other stakeholders), these buildings include variable speed drives, additional building envelope insulation, and energy-efficient lighting and HVAC systems. The buildings were designed to be 25%

[7] *Based on averages for each building type determined by the Department of Energy.*

NEW YORK COLLABORATIVE FOR HIGH-PERFORMANCE SCHOOLS (NY-CHPS)

NYSERDA worked with the New York State Education Department to develop NY-CHPS, a program based on the Collaborative for High-Performance Schools, originally started in California. The program is designed to provide an outstanding learning environment; a healthy, safe place to work; durability; cost-effectiveness over the life of a building; optimization of resources; and the long-term benefits of energy efficiency.

The NY-CHPS *High-Performance Schools Guidelines* include a score sheet for benchmarking high-performance schools. The score sheet allows for a maximum of 133 credits, and includes the following sections:

- Site (15 points)
- Energy (26 points)
- Materials (26 points)
- Water (3 points)
- Indoor Environmental Quality (32 points)
- Operations and Maintenance (15 points), and
- Extra Credit (16 points)

Source: NYSERDA, 2007.

more energy-efficient than state building energy code requires.

Web site: *http://www.nyserda.org/programs/state.asp.*

Pennsylvania – High Performance Green Building Program

The Pennsylvania Governor's Green Government Council (GGGC) works in partnership with over 40 state agencies to stimulate the development and continuous improvement of environmentally sustainable practices in planning, policymaking, and regulatory operations. The GGGC established a High Performance Green Building Program that focuses on education, promotion, and demonstration of high-performance green buildings. Its *Guidelines for Creating High Performance Green Buildings* describe how the design and construction of high performance green buildings represent the best possible course for combining environmental responsibility and economic opportunity. The Department of Environmental Protection occupies six LEED-certified buildings, and the state Housing Finance Authority and Turnpike Commission headquarters both occupy LEED-certified buildings. Six additional buildings are expected to earn LEED certification in the near future (Pennsylvania DEP, 1999; Pennsylvania DEP, 2002; GGGC, 2006; GGGC, 2006b; GGGC, 2008).

In implementing and reviewing the results of its High Performance Green Building Program, the state discovered that a relatively low percentage of its green buildings were achieving superior energy performance. In 2003, the state began coordinating with EPA's ENERGY STAR program and DOE's Rebuild America program to incorporate energy efficiency elements from these programs into its green building program. The state created a staff position to manage the integration of ENERGY STAR and Rebuild America with the green building program. The integration activities have included training sessions for Department of Environmental Protection staff on how to use ENERGY STAR tools to facilitate benchmarking and track the energy performance of the state's green buildings (U.S. EPA, 2005d). The state is exploring the possibility of establishing a system that would mandate minimum point requirements in certain LEED categories in addition to a requirement that new state buildings receive at least 85 points under ENERGY STAR certification (IEc, 2005).

Web site: *http://www.gggc.state.pa.us/gggc/cwp/view.asp?a = 515&q = 156859&gggcNav = |6787|*

Portland, Oregon – Green Building Policy

In 2001, the City of Portland, Oregon adopted a green building policy requiring all new and major retrofits of city-funded or -financed projects to achieve LEED-certified status. In 2005, this policy was modified to require new and major retrofits of city buildings to achieve LEED-Gold certification. Additionally, projects are required to meet the following targets: 75% of construction and demolition waste must be recycled; stormwater, water use, and structural codes must be exceeded by at least 30%; and each project must include an "ecoroof" with at least 70% vegetative coverage or high-reflectance ENERGY STAR-qualified roofing. All buildings are to be commissioned to be eligible for the state Sustainable Building Business Energy Tax Credit and all O&M practices must be consistent with city *Green Building Operations and Maintenance Guidelines* (Portland, 2005).

Web site: *http://www.portlandonline.com/osd/index.cfm?c = 41701&a = 112681.*

THE PENNSYLVANIA CAMBRIA STATE OFFICE BUILDING

The Pennsylvania Department of Environmental Protection's 36,000 square-foot Cambria Office Building was completed in 2000.

- Key design measures included:
  - Passive solar orientation with east/west axis, roof overhangs, north and south facing windows, external light shelves, and clerestories to boost natural daylighting while reducing heating and cooling loads
  - High-performance window glazing, resulting in savings of $30,000 annually at a cost of $15,000
  - High performance insulated concrete form wall systems contribute to HVAC system downsizing
  - Ground source heat pumping system for heating and cooling with 14-kW PV panels mounted on the south-facing roof that provides 28% of the total energy used
  - Building materials selected based on their potential environmental impact and recyclability
- Earned a LEED® Gold rating
- Exceeds ASHRAE standards by 30%
- ENERGY STAR label (rating of 88)
- Building cost was $98 per square foot
- Used 50% less energy than the standard low-rise office building located in the Philadelphia region during first year
- Resulted in energy cost savings of up to 66%

Sources: Ziegler, 2003; NREL, 2004; NREL, 2005.

Wisconsin – Sustainable Facilities Guidelines and Minimum Standards

Executive Order 145, on the *Creation of High Performance Green Building Standards and Energy Conservation for State Facilities and Operations*, called for the reduction of overall energy consumption per square foot in state facilities by 10% by 2008 and 20% by 2010. The order required the Department of Administration to develop energy efficiency goals for state facilities and campuses for 2007, 2008, and 2009. The department was also directed to develop *Sustainable Facilities Guidelines and Minimum Standards* based on LEED criteria, which were published in 2007, and to work with the state Building Commission and Energy Center of Wisconsin to ensure that all new state buildings are constructed to surpass existing commercial building energy codes by 30%. The *Sustainable Facilities Guidelines and Minimum Standards* include requirements that building designs be verified before and during construction, and that building performance be verified once the building becomes operational. The Division of State Facilities ensures that buildings designed achieve their intended performance targets and reports the results of the sustainable building program to the state Building Commission twice annually.

In 2004, the state spent $127 million on energy. It is estimated that the standards will reduce O&M costs for the state's 6,300 buildings by as much as 30% and reduce overall energy consumption per square foot by 10% by 2008 and 20% by 2010. This translates into more than $30 million in annual savings for Wisconsin taxpayers (Wisconsin, 2007b; Wisconsin, 2007).

Web sites: ***http://www.wisgov.state.wi.us/journal_media_detail.asp?locid = 19&prid = 1907*** ***(EO 145)***

http://www.doa.state.wi.us/dsf/masterspec_view_new.asp?catid = 58&locid = 4 ***(Sustainable Facilities Policy and Guidelines)***

THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES BUILDING

Design of the state's first green state office building, the Department of Natural Resources' Northeast Regional Headquarters in Green Bay, included green principles such as daylighting, use of recycled materials and recycled waste, and minimizing the building's footprint. The state invested $70,000 to improve the design of this building and estimates that the improvements will save the state $500,000 over a 20-year period.

Source: Wisconsin, 2006.

Washington, D.C. – Green Building Policy

In 2006, the Washington, D.C. city council passed legislation requiring all publicly-owned and publicly financed buildings be designed to meet LEED-Silver certification standards for environmental performance. To ensure that these buildings achieve optimal energy performance, the legislation includes a requirement that buildings also be designed to earn 75 points on the EPA energy performance rating system, using the ENERGY STAR Target Finder tool. To ensure compliance with these requirements, the legislation mandates reviews by a government agency or a certified third party. The green building program is guided by a Green Building Advisory Committee.

Web site: ***http://green.dc.gov/green/cwp/view,a,1231,q,460953.asp***

2.3 ENERGY-EFFICIENT PRODUCT PROCUREMENT

A number of states are achieving energy, environmental, economic, and other benefits by purchasing energy-efficient products, such as electronics, office equipment, heating and cooling systems, and lighting systems. Purchasing ENERGY STAR-qualified products can save a typical state or local government

CLARIFICATION OF TERMINOLOGY

States can implement energy-efficient product procurement as a stand-alone program or as part of broader programs for purchasing products with other environmental attributes.

Green purchasing is generally used to describe activities that focus on purchasing products and services that have positive energy and environmental attributes, including energy efficiency, recycled content, and reduced toxic content. Energy-efficient product procurement falls within the scope of green purchasing.

While green purchasing focuses on products that have positive energy or environmental attributes, *environmentally preferable product (EPP) procurement* assesses multiple energy and environmental attributes to determine which of these green product(s) are preferable in a given situation. For example, in a facility with poor indoor air quality, paint with low-volatile organic compound (VOC) content is both green and environmentally preferable, while paint with recycled content latex is green, but not the preferable product in this situation. In most situations, energy-efficient products are considered environmentally preferable.

This section focuses on energy-efficient product procurement. However, green purchasing and EPP procurement programs that include energy efficiency are also addressed.

approximately $1.5 million in life-cycle energy and maintenance costs and prevent more than 16,000 tons of CO_2 emissions (U.S. EPA, Undated). Combined, state and local governments across the nation could save more than $750 million annually in energy costs by purchasing energy-efficient products (Harris et al., 2004). In addition, energy-efficient product procurement often involves little or no incremental costs, since conventional products can be replaced with energy-efficient ones on a normal product replacement schedule.

2.3.1 BENEFITS OF ENERGY-EFFICIENT PRODUCT PROCUREMENT

Government leadership in purchasing energy-efficient products for a portfolio of state buildings can produce significant energy, environmental, economic, and other benefits, including:

- *Reduced energy costs*. Because energy-efficient products require less energy to operate than conventional products, they can reduce facility energy loads and achieve energy bill savings on the order of 5% to 10% (LBNL, 2002). ENERGY STAR-qualified products typically use 25% to 50% less energy and can offer consumer energy cost savings of as much as 90% (U.S. EPA, 2007a; U.S. EPA, 2008j). Energy-efficient products can also reduce energy costs indirectly, since they do not generate as much unwanted heat as conventional products, and thus lower cooling loads. Table 2.3.1 summarizes the potential energy cost savings of purchasing energy-efficient products for five product categories. (For more information on the energy savings associated with specific energy-efficient products, see Table 4.3.1, *Rules of Thumb* in Chapter 4.)

- *Reduced GHG emissions and other environmental impacts*. Replacing conventional products with energy-efficient ones can substantially reduce GHG emissions and other environmental impacts by decreasing use of fossil fuel-based energy. Fossil fuel combustion for electricity generation accounts for 40% of the nation's CO_2 emissions, a principle GHG, and 67% of the nation's SO_x emissions and 23% of the nation's NO_x emissions, both of which can lead to smog and acid rain, and results in emissions of trace amounts of airborne particulate matter that can cause respiratory problems for many people (U.S. EPA, 2008s). Replacing 100 conventional light bulbs with compact fluorescent light bulbs (CFLs), for example, can reduce nearly 70,000 pounds of CO_2 emissions over a nine-year product lifetime (U.S. EPA and U.S. DOE, 2008). Table 2.3.1 summarizes the potential CO_2 emission reductions from purchasing energy-efficient products for five product categories.

- *Reduced maintenance costs*. Energy-efficient products often have longer lifetimes than conventional products. Because energy-efficient products require less-frequent replacement, maintenance cost savings over the lifetime of the product can be significant. Reducing the number of times a product needs to be replaced can be especially important when replacement involves handling valuable or antique items, which can be found in many state government facilities.

- *Increased economic benefits through job creation and market development*. State and local governments spend a combined $50 billion to $70 billion to purchase energy-using products each year (Harris et al., 2004). Specifying that these funds be used to purchase energy-efficient products can stimulate the local economy and encourage development of energy-efficient product markets. According to DOE, half of all energy-efficient equipment is purchased from local suppliers (U.S. DOE, 2004).

- *Increased reliability*. When an energy-using product reaches the end of its usable life and "burns out," there is often a period of inactivity before the product can be replaced. Energy-efficient products typically experience less-frequent periods of inactivity because they have longer lifetimes than conventional products. This benefit is particularly important when periods of product inactivity can have serious consequences (e.g., HVAC system failure in extreme heat conditions) (U.S. EPA, 2008x).

- *Improved occupant health*. Some energy-efficient products remove sources of indoor air contaminants. Energy recovery ventilation equipment, for example, can reduce infiltration of air contaminants from outdoors while significantly reducing HVAC energy loads (U.S. EPA, 2003). One study on building performance found that the average reduction in illness as a result of improving air quality in buildings is approximately 40% (Carnegie Mellon, 2005).

TABLE 2.3.1 ESTIMATED ENERGY COST AND CO_2 SAVINGS FROM A SAMPLE OF ENERGY STAR PRODUCTS[a]

Action	Annual Energy Cost Savings	Annual CO_2 Savings (Tons)	Lifetime (years)	Life-Cycle Energy Cost Savings	Life-Cycle CO_2 Savings (Tons)
Replace 5,000 computers and monitors with ENERGY STAR-qualified products and activate power management	$400,000	2,200	4	$1,450,000	13,600
Replace 10 conventional commercial dishwashers with ENERGY STAR-qualified products	$11,500	400	10	$128,000[b]	6,000
Replace 50 conventional vending machines with ENERGY STAR-qualified products	$7,500	64	14	$79,200	890
Replace 100 conventional water coolers with ENERGY STAR-qualified coolers	$3,300	28	10	$26,500	280
Replace 50 color laser printers with ENERGY STAR-qualified printers	$660	6	5	$3,000	28

[a] *Figures obtained from calculators on the ENERGY STAR Purchasing & Procurement Web site http://www.energystar.gov/purchasing using default settings and an electricity rate of 9.039¢ per kWh. Annual costs exclude the initial purchase price and installation cost. All costs are discounted over the product's lifetime using a real discount rate of 4%.*

[b] *Value includes water savings.*

2.3.2 PLANNING AND IMPLEMENTATION STRATEGIES RELATED TO ENERGY-EFFICIENT PRODUCT PROCUREMENT

When planning and implementing energy-efficient product procurement activities, states can follow many of the energy management steps described in Section 2.1, *Energy Efficiency in Buildings*. Other key strategies include:

ENERGY STAR QUALIFICATION

Through the ENERGY STAR program, EPA and DOE develop energy performance specifications for more than 50 product categories. ENERGY STAR-qualified products typically use 25% to 50% less energy and can offer consumer energy cost savings of as much as 90% relative to conventional products.

State governments often include requirements in energy-efficient product procurement policies for purchasers to specify products that are ENERGY STAR-qualified. For example, Washington, D.C. passed an act in 2004 to amend its procurement policy to require agencies to include specifications for ENERGY STAR-qualified products in solicitations for energy-using products.

Sources: U.S. EPA, 2006b; U.S. EPA, 2008; LBNL, 2002; Washington, D.C., 2004.

- *Adhere to energy efficiency standards and specifications.* Many state governments require energy efficiency certification for the energy-using products they purchase. Using established standards streamlines the procurement process and can lead to greater energy benefits, since products will be required to meet minimum performance specifications. A number of states, such as Arizona, California, Pennsylvania, Connecticut, and Michigan, require government purchasers to specify ENERGY STAR-qualified products. EPA's ENERGY STAR program provides energy efficiency specifications for more than 50 product categories. For some categories where ENERGY STAR specifications do not exist, FEMP designates energy-efficient products that perform in the top 25% in terms of energy performance (FEMP, 2007).[8]

- *Aggregate purchases*. Some states have reduced procurement costs by designating a particular government agency as the coordinating facilitator of all state agency purchases, which can enable bulk purchases of energy-efficient products (U.S. DOE, 2006j). Some states, such

[8] *FEMP's specifications are consistent with ENERGY STAR's in categories where ENERGY STAR specifications exist (FEMP, 2007).*

ENERGY STAR PRODUCT SAVINGS CALCULATORS

More than 40 product calculators are available that illustrate the cost-effectiveness of selecting ENERGY STAR-qualified products. Purchasers can use these tools to quantify the financial benefits of energy efficiency when making the case for purchasing energy-efficient products to product specifiers.

Calculators can be found at: *http://www.energystar.gov/index.cfm?c=bulk_purchasing.bus_purchasing*

Source: U.S. EPA, 2008i.

as Wisconsin and Connecticut, allow local governments to use state government contracts to aggregate purchases (Harris et al., 2004).

- *Borrow from sample procurement language*. State governments can use model contract language to specify energy-efficient products when making purchases. Model contract language can be borrowed from other government and non-governmental organizations. Both EPA's ENERGY STAR program and FEMP, for example, provide general procurement contract language for purchases of energy-efficient products (U.S. EPA, 2008k; FEMP, 2007).

- *Combine energy-efficient product procurement with other LBE activities*. Because many energy-efficient products have little or no cost premium, energy-efficient product procurement can improve the cost-effectiveness of a comprehensive LBE program. Replacing conventional products with energy-efficient ones on a regular replacement schedule can have little additional cost, but can reduce the costs of meeting targets for building energy performance, green power purchases, and clean energy supplies (Harris et al., 2004). Many states have incorporated energy-efficient product procurement into broader commitments to improving energy efficiency in their building portfolios. For more information on improving energy efficiency across a portfolio of buildings, see Section 2.1, *Energy Efficiency in Buildings*.

- *Create strong links between the Purchasing Department and Energy, Environment, and IT Department(s)*. Fostering collaboration between these departments can significantly enhance the benefits of energy-efficient product procurement activities by bringing together individuals with technical expertise in complementary subjects. Purchasers, who have familiarity with vendors and purchasing procedures, can consult with energy and environmental staff to identify priority energy-efficient products and to quantify the benefits of energy-efficient product procurement policies (e.g., by using ENERGY STAR product savings calculators). Purchasers can also work with staff from IT and facilities management departments who are often responsible for specifying office electronics and for implementing energy efficiency policies, such as enabling sleep modes on office electronic equipment.

- *Require life-cycle cost analyses*. Traditional procurement policies sometimes promote methods for assessing project cost-effectiveness that encourage the purchase of products that have the lowest initial design and construction costs. These policies can prevent state agencies from purchasing energy-efficient products that generate energy cost savings but have higher initial costs. Because the life-cycle cost of an energy-efficient product is typically less than that of a conventional product, many states are requiring agencies to compare products using life-cycle cost analyses that account for the present value of all costs associated with the product (including initial costs, future energy costs, and other ancillary costs) over the product's lifetime. In states with mandatory low-bid procurement requirements, legislative authority may be required to modify procurement policies (U.S. EPA, 2006a).

- *Incorporate information on the payback periods of energy-efficient products into investment decisions*. Life-cycle cost analyses can reveal short payback periods (i.e., the length of time required to recoup up-front costs) for most energy efficiency investments. Incorporating investments with short payback periods into a comprehensive energy efficiency upgrade can help reduce the overall payback period for the entire project. For example, purchasing energy-efficient products that reduce supplemental loads, which typically have short payback periods, can generate significant energy cost savings that can shorten the payback period for a building upgrade as a whole. Similarly, behavioral adjustments, such as setting thermostats at lower temperatures in the winter, can often be implemented at no cost yet produce significant savings and reduce the payback period of a comprehensive upgrade. Table 2.3.2, *ENERGY STAR Specification Overviews: Energy Savings and Cost-Effectiveness*, illustrates the payback periods for a variety of energy-efficient products.

- *Train energy-efficient product users*. Even as policies are put in place to encourage the purchase of energy-efficient products, their results are not guaranteed. It is important to educate purchasers to help them identify what products are energy-efficient and track the effectiveness of procurement activities (NACo, Undated).

TABLE 2.3.2 ENERGY STAR SPECIFICATION OVERVIEWS: ENERGY SAVINGS AND PAYBACK PERIODS[a]

Product Category	Effective Date of Current Specification	Percent Energy Savings Compared to Conventional Product	Payback Period
Appliances			
Dehumidifiers	October 2006	15%	0 years (typically no retail cost premium)
Dishwashers	January 2007	40%	0 years (typically no retail cost premium)[b]
Refrigerators and freezers	April 2008	15%	4 years (refrigerators)[c] 6 years (freezers)[d]
Room air conditioners	November 2005	10%	Not available
Room air cleaners	July 2004	45%	0 years (typically no retail cost premium)
Electronics			
Battery charging systems	January 2006	35%	0 years (typically no retail cost premium)
Cordless phones	November 2006	55%	0 years (typically no retail cost premium)
Combination units	July 2005	30%	0 years (typically no retail cost premium)
DVD products	January 2003	60%	0 years (typically no retail cost premium)
External power adapters	January 2005	35%	0 years (typically no retail cost premium)
Home audio systems	January 2003	60%	0 years (typically no retail cost premium)
Televisions	November 2008	25%	0 years (typically no retail cost premium)
Envelope			
Roof products	December 2007	Not available	< 4 years
Windows, doors, and skylights	September 2005	Not available	Not available
Lighting			
Compact fluorescent lamps	January 2004	75%	< 1 year
Residential-style light fixtures	August 2008	75%	< 1 year 2 years for recessed cans
Office Equipment			
Computers	July 2007	25% — 50%	0 years (typically no retail cost premium)
Copiers	April 2007	65%	0 years (typically no retail cost premium)
Monitors	July 2007	25%	0 years (typically no retail cost premium)
Multifunction Devices	April 2007	20%	0 years (typically no retail cost premium)
Printers, fax machines, and mailing machines	April 2007	15%	0 years (typically no retail cost premium)
Scanners	April 2007	50%	0 years (typically no retail cost premium)
Heating and Cooling			
Air source heat pumps	April 2006	5%	< 5 years
Boilers	April 2002	5%	< 1 year

TABLE 2.3.2 ENERGY STAR SPECIFICATION OVERVIEWS: ENERGY SAVINGS AND PAYBACK PERIODS *(cont.)*

Product Category	Effective Date of Current Specification	Percent Energy Savings Compared to Conventional Product	Payback Period
Ceiling fans	September 2006	45%	0 years (typically no retail cost premium)
Furnaces	October 2006	15%	< 3 years
Geothermal heat pumps	April 2001	30%	< 5 years for new construction
Light commercial HVAC	January 2004	5%	< 1 year
Ventilating fans	October 2003	70%	0 years (typically no retail cost premium)
Commercial Food Service			
Commercial dishwashers	October 2007	30%	2 years
Commercial fryers	August 2003	15%	2 years (for typical unit)
Commercial hot food holding cabinets	August 2003	65%	2 years
Commercial ice makers	January 2008	25% — 30%	4 years (for typical unit)
Commercial solid door refrigerators and freezers	September 2001	35%	1 year
Commercial steam cookers	August 2003	50%	0 years (typically no retail cost premium)
Other			
Water coolers	May 2004	45 %	0 years (typically no retail cost premium)
Vending machines	April 2004 August 2006 (rebuilt machines)	40 %	< 1 year

[a] *ENERGY STAR develops performance-based specifications to determine the most energy-efficient products in a particular product category. These specifications, which are used as the basis for ENERGY STAR qualification, are developed using a systematic process that relies on market, engineering, and pollution savings research and input from industry stakeholders. Specifications are revised periodically to be more stringent, which has the effect of increasing overall market energy efficiency (U.S. EPA, 2007d).*

[b] *U.S. EPA and U.S. DOE, 2007c.*

[c] *U.S. EPA and U.S. DOE, 2007b.*

[d] *U.S. EPA and U.S. DOE, 2007.*

[e] *U.S. EPA and U.S. DOE, 2007d.*

[f] *U.S. EPA and U.S. DOE, 2008.*

2.3.3 STATE AND LOCAL EXAMPLES OF ENERGY-EFFICIENT PRODUCT PROCUREMENT

Energy-efficient product procurement activities have been implemented at the state and local government levels using a variety of implementation approaches. The following are examples of state and local government energy-efficient product procurement activities.

Massachusetts – Environmentally Preferable Products Procurement Program

The primary goal of the state's Environmentally Preferable Products Procurement Program is to use the Commonwealth's purchasing power to reduce the environmental and public health impacts of state government and foster markets for environmentally preferable products. The program, which covers a wide range of products and services (including those that reduce energy consumption, contain recycled content, minimize waste, conserve water, and reduce the disposal or consumption of toxics), uses statewide contracts for environmentally preferable products and provides educational assistance and technical expertise to state agencies and local governments. It also offers workshops to procurement officials and sponsors an annual vendor fair and conference. In recent years, the program staff have collaborated on a national level with procurement officials and other organizations to pull together resources for responsible environmental purchasing.

In FY 2001, the state spent $92.5 million on environmentally preferable products, including approximately 11,000 computers, 7,600 monitors, 1,200 copiers, and 120 fax machines. The cost savings from the program in 2001 surpassed $544,000, with the savings from purchasing energy-efficient office equipment accounting for approximately $270,000 (Massachusetts, 2003). The overall environmental benefits were substantial. It is estimated that the program enabled the state to avoid over 4,000 metric tons of carbon equivalent; more than 11,000 barrels of oil equivalent; over 60,000 trees harvested; and 625,000 feet of fluorescent lamps (Massachusetts, 2007b).

Web site: *http://www.mass.gov/?pageID = osdtopic&L = 3&sid = Aosd&L0 = Home&L1 = Buy+from+a+Contract&L2 = Environmentally+Preferable+Products+(EPP)+Procurement+Program (Program)*

http://www.mass.gov/Aosd/docs/EPP/EPP%20Program%20Assessment%20Final%20Report%20Dec02.doc (2003 Report)

New York City – Energy-Efficient Product Procurement

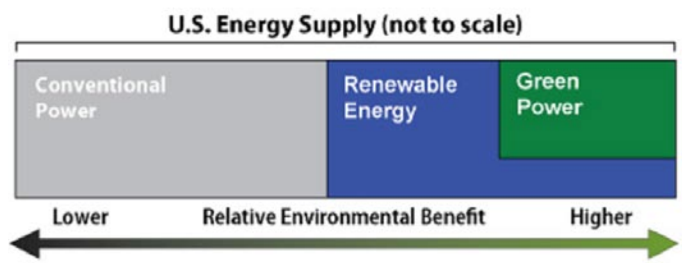
Enacted on April 11, 2003, New York City Local Law 30 requires that energy-using products procured by the city be ENERGY STAR-qualified, provided that there are at least six competing manufacturers of the ENERGY STAR product. During FY 2002, New York City spent $90.8 million for ENERGY STAR-qualified products, consisting mainly of computers, monitors, printers, photocopiers, fax machines, televisions, VCRs, air conditioners, and lamps. Local Law 30 was expanded by Local Law 119 in 2005, which adds a requirement that FEMP water and energy efficiency standards be considered in conjunction with ENERGY STAR when making purchases (New York City Council, 2007; New York City Council, 2005).

Web site: *http://www.nyccouncil.info/search/searchlook2.cfm?SEARCH = NUM.*

2.4 GREEN POWER PURCHASES

Purchasing green power for their portfolio of facilities is another way state and local governments are leading by example. Green power refers to renewable electricity that is produced with no man-made GHG emissions, has a superior environmental profile compared to conventional power generation, and was built after January 1, 1997.[9] This subset of renewable energy resources includes solar, wind, biogas, biomass, low-impact hydro, and geothermal resources. Other renewable energy resources, such as waste-to-energy and hydropower, are not necessarily green power resources, since they can have adverse environmental impacts, such as air pollution or natural landscape disruption (U.S. EPA, 2004b; U.S. EPA, 2007h).

FIGURE 2.4.1 GREEN POWER AND RENEWABLE ENERGY



States can consider several options for purchasing green power. At the point of generation, green power can be sold directly to the customer or separated into its two components: the physical electricity and the technological and environmental attributes. When sold directly to the customer, green power is often supplied as a fixed percentage of monthly use but can also be provided in fixed-quantity blocks (e.g., a 100 kW block of green power). When the two components are separated, the technological and environmental attributes associated with renewable energy are sold as renewable energy certificates (RECs) (also known as *green tags* or *tradable renewable certificates*). The physical electricity, no longer "bundled" with the technological and environmental attributes, is sold through the grid indistinguishable from electricity generated from conventional sources (U.S. EPA, 2007r). RECs can be purchased directly from the renewable electricity generator or

[9] January 1, 1997 is the accepted date marking the beginning of the voluntary green power market. It is argued that renewable energy generation facilities built after this date are the product of increasing market demand for green power, rather than the product of regulatory action, such as renewable portfolio standards, that required utilities to use renewable energy.

through several types of REC providers, including retail and wholesale REC marketers (e.g., utilities, non-profits, or other environmental foundations) and REC brokers (U.S. EPA, 2004b; WRI, 2003).

Green power premiums vary, with the national average green power premium being 2.12¢ per kWh in 2006, a decrease of 8% from the 2.36¢ per kWh average in 2005 (Bird et al., 2007). Green power premiums can range as high as 3¢ per kWh, but in many places are much lower (U.S. DOE, 2007e; U.S. DOE, 2007f).

EPA GREEN POWER PARTNERSHIP

The EPA Green Power Partnership is a voluntary program developed by EPA to boost the market for green power sources that do not contribute GHG emissions to the atmosphere. State and local governments participating in the partnership receive EPA technical assistance and public recognition.

Through April 2008, two states and seven agencies in other states were participating in the Green Power Partnership. In addition, more than 80 local governments have committed to meeting the partnership's green power purchase requirements.

Source: U.S. EPA, 2008l.

2.4.1 BENEFITS OF PURCHASING GREEN POWER

By committing to purchasing green power for their portfolio of facilities, states can achieve numerous energy, environmental, economic, and other benefits, including:

- *Hedge against financial risks*. Because green power is not as sensitive to market fluctuations and supply limitations as fossil fuel-based electricity, purchasing green power reduces a state government's susceptibility to fossil fuel price volatility.[10] Since green power is produced from renewable energy sources, it can often be purchased at a more stable (and sometimes fixed) price over the long term (U.S. EPA, 2004b; NYSERDA, 2003).
- *Reduced GHG emissions and other environmental impacts*. Fossil fuel combustion for electricity generation accounts for 40% of the nation's CO_2 emissions, a principle GHG, and 67% of the nation's SO_x emissions and 23% of the nation's NO_x emissions, both of which can lead to smog and acid rain, and results in emissions of trace amounts of airborne particulate matter that can cause respiratory problems for many people (U.S. EPA, 2008s). Using green power, which is produced with no anthropogenic GHG emissions, can substantially reduce a state's GHG emissions and other environmental impacts by decreasing use of fossil fuel-based electricity.
- *Increased regional employment*. Purchasing green power can create and sustain regional jobs, since manufacturing, installing, and maintaining renewable energy generation systems requires a significant amount of effort. To manufacture, construct, install, and maintain one MW of solar photovoltaics, for example, approximately 22 jobs are sustained (Apollo Alliance, 2007).
- *Regional and national benefits*. State governments can help achieve regional- and national-scale energy benefits by increasing the amount of green power in the country's energy portfolio. This reduces dependence on imported fossil fuels and diversifies the nation's fuel resources, which can improve the overall robustness of the country's energy systems by reducing dependence on a vulnerable, centralized energy delivery infrastructure (U.S. EPA, 2004b).

[10] *Anticipation of federal and/or state legislation that could impose caps on GHG emissions also has the potential to exacerbate the volatility of fossil fuel prices (U.S. EPA, 2004b).*

BENEFITS OF PURCHASING RENEWABLE ENERGY CERTIFICATES (RECS)

- RECs create green power opportunities for electricity customers in areas that lack access to utility products and can create additional supply and cost options for customers with access to utility products.
- RECs enable customers to maintain existing procurement relationships with electricity providers.
- RECs provide green power opportunities for customers in leased spaces where control of electricity purchases is retained by a landlord.
- REC purchasers can specify the green power source type and location from which the RECs are derived.
- RECs often have a lower cost premium than green power purchased directly from the utility.

2.4.2 PLANNING AND IMPLEMENTATION STRATEGIES FOR GREEN POWER PURCHASING

Key planning and implementation considerations that can lead to enhanced effectiveness for green power procurement activities include:

- *Aggregate purchases*. A number of states are aggregating electricity demand to purchase green power. By combining the needs of a number of agencies, state they are often able to negotiate lower prices with the utility, making green power purchases more affordable (U.S. EPA, 2006a). For example, the Maryland Department of General Services recently coordinated with the University of Maryland system in aggregating purchases from 4,300 state accounts, procuring over 1.4 billion kWh. This effort is expected to save the state more than $31.3 million over a two-year period (Maryland, 2006).

- *Combine green power purchases with energy efficiency upgrades*. State governments can reduce the cost of meeting green power purchase targets by complementing green power purchases with energy efficiency upgrades. Improving energy efficiency in a facility reduces electricity loads, meaning percentage green power goals can be met at reduced costs.

- *Require certification for green power products*. State governments can require that green power products be certified as meeting consumer protection and environmental standards. Certification provides assurance that green power products reduce a state government's environmental impacts. Certification can also verify that green power product claims are valid (e.g., with respect to the mix of renewable energy resources) and that the products have not been repackaged (U.S. EPA, 2006a; AWEA, 2004).[11] Certification is conferred by a number of organizations, including the Green-e Renewable Energy Certification Program and the Environmental Resources Trust (U.S. DOE, 2007).

- *Seek fixed-price, long-term contracts*. Because green power generation requires no fuel input and is not subject to fuel price volatility, it comes at a consistent cost to the generator, meaning customer prices remain relatively stable over time. While short-term contracts might offer greater future flexibility, long-term contracts can reduce a supplier's risk, which often translates into reduced rates (U.S. EPA, 2004b; WRI, Undated).

PENNSYLVANIA DOUBLES GREEN POWER PURCHASE COMMITMENT

On August 29, 2006, Pennsylvania Governor Ed Rendell announced that the state would be doubling its 2003 green power purchase commitment, increasing the amount of renewable energy as a percentage of overall electricity consumed from 10% to 20%. This increase was achieved at a premium rate of 0.34¢ per kWh and was expected to annually reduce 950 tons of SO_2 emissions, 270 tons of NO_x emissions, and 123,000 tons of CO_2 emissions.

In October 2007, the governor announced that the state government had increased its renewable energy purchases to nearly 280 million kWh per year, or approximately 28% of the state government's electricity demand. Of the 280 million kWh, 57% is from wind power and 43% is from hydroelectric. The 160 million kWh drawn from wind resources qualify as green power under the EPA Green Power Partnership.

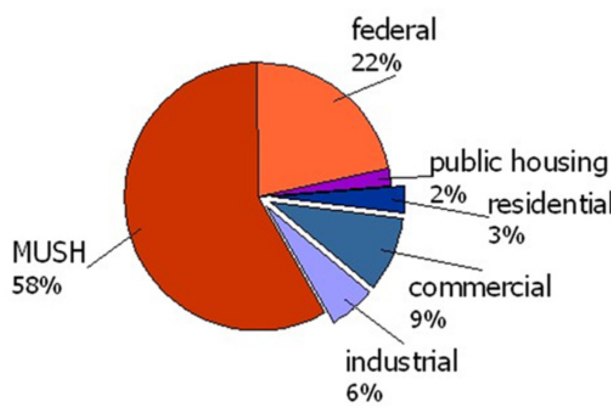
This commitment is expected to support the development of markets for sustainable energy sources, leading to more jobs; enhance national security; and reduce the state's demands on natural resources.

Sources: Pennsylvania, 2006; U.S. EPA, 2006d; Pennsylvania, 2007b.

2.4.3 STATE AND LOCAL EXAMPLES OF GREEN POWER PURCHASES

Compared to other sectors, state and local governments (labelled "MUSH" in the figure below) are responsible for approximately 58 percent of total green power and renewable energy purchases in the U.S.

FIGURE 2.4.1 TOTAL U.S. GREEN POWER AND RENEWABLE ENERGY PURCHASES BY SECTOR



This section highlights examples of these activities.

Connecticut – Green Power Purchases

In September of 2007, through the state's initial purchase of electric supply via a reverse auction process, Connecticut locked in 812 million kWh of supply for a two-year period through June of 2009. A subsequent

[11] *"Repackaging" refers to the concern that green power can be "repackaged" and sold as a mix of renewable energy that is already injected into the grid to satisfy legal mandates (e.g., through renewable portfolio standards) rather than to meet consumer demand. Repackaged renewable energy does not result in environmental improvement, since it merely sustains the status quo (AWEA, 2004). Renewables that are counted toward satisfying mandates may not be used to support purchasers' environmental claims.*

auction for an additional 97 million kWh was held November 29th for supply beginning in January of 2008. The total volume under these contracts for electric supply is for 909 million kWh. Under these supply contracts, 17.5 % of the electric supply (not including RPS) will be green power from Class I renewable sources.

Also in 2008, Connecticut conducted a reverse auction for electric supply. Contracts locked in for this period were for both three and four year periods for a total volume of 2.1 billion kWh. Under these supply contracts, 19% of the electric supply (not including RPS) is for green power from Class I renewable sources. When RPS requirements are factored in, 28% of the electricity used by Connecticut State government will come from Class I renewable sources, exceeding the 20% goal in Governor Rell's 2006 Energy Vision Plan.

Web site: *http://www.ctcleanenergyoptions.com/.*

Maine – Aggregated Purchase Leads to 100% Green Power Coverage

In 2003, the governor's energy agenda established a goal for the state government to purchase at least 50% of its electricity from renewable power sources, using energy efficiency measures in state buildings to offset the cost of the renewable energy. This goal was originally met by a contract agreement committing more than 800 state agency accounts under one service agreement. By March 2007, the state government had increased its renewable energy purchase to cover 100% of power demands. Thirty percent of this total is obtained through the statewide renewable energy portfolio standard, while the remaining 70% is obtained by purchasing RECs (DSIRE, 2007).

Web site: *http://www.dsireusa.org/library/includes/incentive2.cfm?Incentive_Code = ME08R&state = ME&CurrentPageID = 1&RE = 1&EE = 1.*

New Jersey – Aggregated Green Power Purchase

In 1999, the New Jersey Department of the Treasury developed a proposal to lower state government energy costs by aggregating electricity purchases from the accounts of 178 public agencies in the state, thus enabling the group to negotiate lower energy costs through competitive bidding in the state's recently deregulated market. At the same time, the governor issued a mandate that state government agencies obtain at least 10% of their power from renewable resources. Combining the two initiatives resulted in a purchase of nearly 500 million kWh of green power over 52 months. This quantity of energy covers approximately 12% of the overall electricity requirements for the agencies' facilities. The effort has resulted in an estimated avoidance of 168,948 metric tons of CO_2 emissions, which is equivalent to removing 32,490 cars from the road for one year (New Jersey, 2003).

Web site: *http://www.state.nj.us/dep/dsr/bscit/GreenPower.pdf.*

Montgomery County, Maryland – Wind Power Purchase

In 2004, Montgomery County, Maryland represented a group of six county agencies, 11 municipalities, and a neighboring county in completing the largest ever local government purchase of wind energy. The agreement with Washington Gas Services and their wind energy supplier, Community Energy, Inc., is for more than 38.4 million kWh annually over two years, representing 5% of the group's aggregate energy demand. The deal will produce significant environmental benefits. The emissions avoided through this purchase include over 19,000 metric tons of CO_2 (equivalent to 36 million miles not driven) and 43 tons of NO_x (equivalent to 2.9 million trees) (Montgomery County, 2006; U.S. EPA, 2007i).

Web site: *http://www.montgomerycountymd.gov/Apps/News/press/DisplayInfo.cfm?ItemID = 895.*

2.5 CLEAN ENERGY SUPPLY

Clean energy generation technologies, which can have significant state, regional, and national benefits, include on-site energy generation from renewable sources (e.g., wind, photovoltaics, biomass, and hydroelectric power systems) and clean distributed generation (DG) technologies. Clean DG refers to small, decentralized,

VIRGINIA – SOLAR POWER AT NEW STATE FACILITIES

The governor of Virginia issued Executive Order 48 in 2007. The order established a broad commitment to reducing non-renewable energy consumption across state government by 20% by 2010, based on 2006 levels.

The order proposes a strategy for meeting this goal. Included in this strategy is a directive for the state Senior Advisor for Energy Policy periodically assess the cost-effectiveness of incorporating PV system installations in any roofing retrofit for buildings over 5,000 square feet. Where PV system installations with a payback period of 15 years or less are feasible, the Department of General Services will be required to implement the measure.

Source: Virginia, 2007.

grid-connected or off-grid energy generating units, such as combined heat and power (CHP) systems, that are located at or near user facilities to meet on-site energy needs. The benefits of these technologies can be significant. For example, a CHP system with a 75% total system efficiency can consume up to one-third less energy than a separate heat and power (SHP) system with a total system efficiency of 49% (U.S. EPA, 2007c).[12]

Many states are leading by example by meeting government building energy demands with clean energy generated on-site. New Mexico and California, for example, require new construction of state facilities to include on-site energy generation, where possible (California, 2001; New Mexico, 2005). The Arizona Working Group on Renewable Energy and Energy Efficiency has called for the governor to require state facilities to produce 5% of their own energy needs through renewable sources by 2012. Utah has produced the *Policy to Advance Energy Efficiency in the State*, which sets a goal of reducing state government energy consumption by 2% by 2015 using renewable energy generated on-site. In 2007, Oregon passed legislation requiring that 1.5% of the total contract price for capital improvements to public facilities be spent on solar energy technologies (Oregon, 2008).

This section describes some of the benefits of generating clean energy on-site, identifies strategies for planning and implementing clean energy generation activities, provides an overview of clean energy generation technologies, and presents several state and local government examples.

[12] *Based on a 5 MW natural gas-fired combustion turbine CHP system (U.S. EPA, 2007b).*

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). In wind power generation, a system's generation capacity is dependent on a site-specific capacity factor, which describes the system's actual annual energy output divided by the annual output if the system is operated at full capacity for the entire year. Thus, 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 (the *Hull 1* turbine in Hull, Massachusetts, for example, operates at 0.27). For most fossil fuel power plants, the capacity factor is about 0.28.

Sources: EIA, 2007; AWEA, 2007b; CEC, 2007; U.S. DOE, 2007g.

2.5.1 BENEFITS OF USING CLEAN ENERGY

By committing to using clean energy supplies for their portfolio of facilities, states can achieve numerous energy, environmental, economic, and other benefits, including:

- *Hedge against financial risk*. As with purchasing green power, using clean energy can provide a hedge against financial risks because clean energy supplies are not as sensitive to market fluctuations and supply limitations as fossil-fuel based electricity. Reduced susceptibility to market volatility can translate into lower operating costs (U.S. EPA, 2004b). In addition, generating clean energy on-site can sometimes be cheaper than purchasing electricity through the grid. For example, the electricity from two wind turbines in Hull, Massachusetts is generated at a cost of 3.4¢ per kW, which is less than half of the 8.0¢ per kW it would cost the local government to purchase electricity from the grid (Hull, 2008). When inflation and discount rates are taken into account, the cost per kWh rises to 5.3¢, still well below the cost of purchased electricity (Manwell et al., 2003). Hull has a municipal electric company, which means that it distributes the electricity generated by the wind turbines to customers in the town, and does not need to sell the electricity to the grid. In towns without a municipal electric company, the value of the power produced is the selling price of energy. In Hull, the value of the power produced is the avoided cost of purchasing from the grid (RERL, 2006).
- *Reduced GHG emissions and other environmental impacts*. Fossil fuel combustion for electricity generation accounts for 40% of the nation's CO_2 emissions, a principle GHG, and 67% of the nation's SO_x emissions and 23% of the nation's NO_x emissions, both of which can lead to smog and acid rain, and result in emissions of trace amounts of airborne particulate matter that can cause respiratory problems (U.S. EPA, 2008s). Using clean energy can significantly reduce a state government's GHG emissions and other environmental impacts by decreasing use of fossil-fuel based energy. CHP systems, for example, can reduce CO_2 emissions by more than 50% compared to SHP systems (U.S. EPA, 2007j).
- *Electricity grid benefits*. Using clean energy supplies reduces reliance on conventional energy from centralized generation sources. Decreasing the amount of electricity the regional grid is required to transmit and distribute can lower the risk of blackout and reduce electricity losses in transmission lines. Clean energy

supply systems can significantly reduce the amount of energy lost in transmission from source to site. Distributed generation CHP applications, for example, achieve effective electrical efficiencies between 50% and 70%, as opposed to 33% for conventional fossil fuel powered plants (U.S. EPA, 2006e).

2.5.2 PLANNING AND IMPLEMENTATION STRATEGIES RELATED TO USING A CLEAN ENERGY SUPPLY

Key planning and implementation considerations that can lead to enhanced effectiveness for clean energy supply activities include:

- *Bundle clean energy supply with energy efficiency improvements*. Energy efficiency activities can reduce the cost of meeting percentage clean energy generation goals. Increased energy efficiency means less grid-based electricity is required to supplement the production of on-site renewable energy generation systems.

- *Complement clean energy supplies with green power purchases*. States can achieve increased GHG emissions reduction benefits by complementing on-site renewable energy generation with green power purchases. Using clean energy supplies can also reduce the cost of meeting percentage green power purchase targets, since these targets are often based on reducing grid-based electricity purchases.

- *Use the Solar Services Model.*[13] States can use the solar services model to finance solar PV system purchases and installations with no up-front cost. Under this model, the state signs a long-term (often ten years) power purchase agreement with a developer to host a PV system on its facility. The developer then pays for the design, construction, and installation of the system, often arranging for third-party financing through an investor. The developer uses revenue from the host's electricity payments to pay off financing debt to the investor. The host's payments are pre-determined and are assessed much like a monthly utility payment. The state government, as host, benefits from fixed-price payments, reduced peak energy costs, and reduced GHG emissions 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 (Sandia, 2007; WRI, 2007).

2.5.3 CLEAN ENERGY GENERATION TECHNOLOGIES

This section provides an overview of renewable energy generation and clean DG technologies that can be implemented at state government facilities.

Renewable Energy Generation Technologies

- *Wind*. Capturing wind energy using on-site turbines can significantly reduce grid-based electricity purchases. For example, a 3-kW turbine[14] with a 60 to 80 foot tower installed at a facility with monthly electricity costs ranging between $60 and $100 (approximately 700 kWh to 1100 kWh) could reduce the facility's monthly electricity bill by 30% to 60% [AWEA, Undated(c)].[15] The national average installed cost for wind projects in 2006 was approximately $1,480 per kW capacity (U.S. DOE, 2007b).

- *Solar*. Heat and light from the sun provide abundant sources of renewable energy. Solar energy is captured using multiple technologies, including:

  - *Photovoltaics (PV)*. PV systems directly convert sunlight into electricity using solar cells. These systems can produce electricity even in the absence of strong sunlight. A 10-kW system could produce 15,000 kWh annually. In a 20,000 square foot office building that uses 15.5 kWh per square foot,[16] this system could reduce grid-based electricity purchases by approximately 5%. PV systems are often installed on roof tops, making them suitable for urban government buildings. Since 2006, California has installed more than 4 MW of PV capacity on state facilities. In 2008, the state is planning to install as much as 24 MW additional PV capacity on state facilities (California DGS, 2008).

  - *Solar Hot Water*. Passive solar hot water technology uses sunlight to heat water that is distributed throughout a building to provide central or space

[13] *The solar services model is also referred to as an independent energy purchase (IEP).*

[14] *"Small wind" turbines (turbines that have capacities of 100 kW or less) are often better suited for installation at or near state facilities than large utility-scale wind farm turbines, which can reach capacities as high as 3 MW [AWEA, Undated(c); U.S. EPA, 2004b].*

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

[16] *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, 2007k).*

heating, reducing a building's reliance on a conventional hot water heater that uses non-renewable energy sources (NREL, 2007b; NREL, 2007c).

- *Solar Process Heating and Cooling*. Solar process heating technology captures heat from sunlight using contained air or fluid as the medium. The captured heat is then fanned or pumped throughout a building to provide space heating. This technology can also be reversed to cool buildings (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, water is piped underground where geothermal heat produces steam, which can be used to produce electricity using steam turbines. This type of geothermal application is dependent on the availability of adequate geothermal reservoirs (reservoirs of water with temperatures between 68° F and 302° F), most of which are located in the western United States. The Idaho state capitol, for example, is heated using direct use geothermal technology (Idaho, 2008).

  A second type of geothermal technology involves capturing the earth's heat to warm liquid that is then pumped into buildings 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, 2006k). Geothermal heat pump systems are installed at shallow depths (sometimes as shallow as 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, 2007c).

- *Biomass*. Electricity-producing turbines can be fueled by burning biomass (e.g., plant material, wood, agricultural wastes, and manure). In addition, biomass can be converted into combustible oil or gas biofuel by heating it in an oxygen-free environment, a process that can be twice as efficient as burning biomass (U.S. EPA, 2000; U.S. EPA, 2004b).

- *Landfill and Sewage Methane Gas*. Fitting landfills and wastewater treatment facilities to capture methane, which can be combusted to produce electricity, provides a source of energy from a byproduct that would otherwise be wasted. A single methane recovery project can produce as much as 4 MW of electricity while reducing waste odors and pathogens (U.S. EPA, 2004b; U.S. EPA, 2006a). In addition, a 3 MW landfill methane project can support more than 70 full-time jobs over the course of a year [U.S. EPA, Undated(b)].

- *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. There are currently 89 operational municipal solid waste energy generation facilities in the U.S. that produce a combined 2,500 MW (U.S. EPA, 2006h).[17]

- *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, 2006k). The Low-Impact Hydropower Institute (LIHI) confers certification on hydropower projects that demonstrate minimal impact on the environment (LIHI, 2008).[18]

ARIZONA WESTERN ARMY AVIATION TRAINING SITE SOLAR FARM

The Arizona Department of Emergency and Military Affairs uses a solar farm to supplement its energy usage at the Army Aviation Training Site. The $196,000 photovoltaic system produces 31 kW of electricity, which has resulted in an annual reduction of an estimated 113,000 kWh of electricity that would otherwise be purchased from utilities. These savings equate to approximately $20,000 in energy cost savings annually. The Department estimates that the installation has resulted in a 31% decrease in utility costs.

Sources: Arizona DOC, 2006; Arizona, 2007.

UTAH SOLAR POWER DEMONSTRATION

The governor's *Policy to Advance Energy Efficiency in the State* calls on the state government to establish programs to install on-site renewable energy sources to reduce energy consumption by 2% by 2015 compared to 2005 levels. The governor's office is currently working in coordination with the Utah Geological Survey and the State Energy Program to fund a 1.28 kW solar power and demonstration project at the Department of Natural Resources facility in Salt Lake City. Installation of the solar panels was conducted in conjunction with a six-day course on the benefits of solar technology.

Source: Utah, 2006.

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[17] *While burning MSW can produce energy and reduce waste streams, it is important to note that MSW combustion can also produce NO_x, SO_2, and CO_2 emissions if not rigorously monitored. The EPA Green Power Partnership does not recognize electrcity generated from MSW combustion as green power (U.S. EPA, 2007l).*

[18] *The EPA Green Power Partnership recognizes only hydroelectricity generated by LIHI-certified projects.*

- *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, 2004b).

Clean Distributed Generation Technologies

- *Microturbines*. Microturbines are small combustion turbines with typical energy generation capacities between 25 kW and 500 kW. Microturbines, when used in CHP systems, can achieve efficiency levels greater than 80% (U.S. DOE, 2006m).

THE COMBINED HEAT AND POWER PARTNERSHIP

The EPA CHP Partnership seeks to reduce the environmental impact of power generation by fostering the use of CHP. The partnership works closely with energy users, the CHP industry, state and local governments, and other stakeholders to support the development of new policies, programs, and projects and promotes their energy, environmental, and economic benefits.

The Partnership provides tools and resources to state and local government, industry, and energy users to encourage deployment of CHP including a CHP Emissions Calculator, Catalog of Technology, and CHP and Biomass Funding Database.

Through April 2008, thirteen state government agencies and three local governments were participating in the CHP Partnership.

Sources: U.S. EPA, 2006f; U.S. EPA, 2006g.

- *Gas-Fired Reciprocating Engines*. Reciprocating engines can generate between 0.5 kW and 6.5 MW of electricity. These engines have low capital costs, are easy to operate, have proven reliability, and can be used in CHP applications (U.S. DOE, 2006n).

- *Combined Heat and Power*. Combined heat and power (CHP), also known as cogeneration, refers to the simultaneous production of electricity and thermal energy from a single fuel source. CHP systems consist of three primary components: the unit in which the source fuel is combusted, the electric generator, and the heat recovery unit. CHP systems are differentiated by their type of prime mover, or device they use to convert fuel into electricity (e.g., microturbines, gas turbines, and steam turbine prime movers). Prime movers can operate using several kinds of fuel, including natural gas, biomass, biogas, coal, waste heat, and oil.

There are many opportunities for CHP systems at state government facilities, particularly:

- *Public schools and universities*. Many states, including California, Ohio, Minnesota, and New Mexico have installed CHP systems at state university campuses to supply campus electric and thermal demands.

- *Correctional facilities*. Correctional facilities are also candidates for CHP systems. Numerous correctional facilities across the country currently have CHP systems, including sites in New Jersey and Minnesota.

- *Wastewater treatment facilities*. Wastewater treatment facilities with anaerobic digesters can be strong candidate sites for CHP systems. The biogas flow from the digester is used as "free" fuel to generate electricity and power in a CHP system. Because they provide critical infrastructure for maintaining public health and the environment, power supply disruptions at these facilities would have serious consequences. Wastewater treatment CHP systems are in place in 23 states, representing 176 MW of capacity (U.S. EPA, 2006g).

2.5.4 STATE AND LOCAL EXAMPLES OF USING CLEAN ENERGY

State and local governments have used a variety of approaches to implement clean energy supply activities. The following descriptions provide state and local government examples of using clean energy supplies.

Oregon – Solar State Buildings

The Oregon Renewable Energy Action Plan, adopted in 2005, contains a number of policy goals and

BAYONNE, NEW JERSEY —SOLAR ELECTRICITY GENERATION IN PUBLIC SCHOOL DISTRICT

In cooperation with the New Jersey Board of Public Utilities, the Bayonne Board of Education installed nearly 10,000 solar panels at the local high school and eight elementary schools that have a combined 2 MW of electricity generation capacity, enough to power 200 small homes for 30 years. The $13.2 million project was made possible in part due to assistance from the state's Clean Energy Program, which provided $5.4 million in solar equipment and installation credits. The project is expected to save the school district more than $500,000 yearly in avoided electricity costs. Additional benefits include reduced reliance on fossil fuels, reduced pollution, and decreased strain on the grid.

Source: New Jersey, 2006.

recommended actions for increasing the amount of renewable energy in the state. Included in this plan are several goals for increasing the amount of renewable energy used by state facilities through purchasing green power and by generating renewable energy on-site. Specifically, the plan directed the state Department of Energy to pursue opportunities to install solar water heating, solar electric, and passive solar technologies at all new public facilities. In 2007, the state passed legislation to enforce this activity. House Bill 2620 requires that 1.5% of the total contract price of a new facility or major renovation be spent on solar technologies. This requirement became effective in January 2008, and the state Department of Energy has published proposed rules to implement the legislation. The rules include information on project eligibility, eligible costs, available solar technologies, use of funds, and reporting requirements (Oregon, 2005; Oregon, 2008).

Web sites: ***http://www.oregon.gov/ENERGY/RENEW/docs/FinalREAP.pdf (Renewable Energy Action Plan)***

http://oregon.gov/ENERGY/CONS/PublicSolar.shtml (HB 2620 Web site)

California – Solar Technology at State Facilities

In 2001, the California state legislature passed a bill requiring the state Department of Administration, in consultation with the State Energy Resources Conservation and Development Commission, to ensure that solar energy equipment be incorporated into designs for new state buildings and parking facilities beginning on January 1, 2003, and that solar energy equipment be installed at existing state buildings and parking facilities by January 1, 2007. Legislation in 2007 extended these respective deadlines to January 1, 2008 and January 1, 2009, respectively. In addition, the governor issued an executive order in 2004 calling on state agencies to reduce non-renewable energy consumption by 20% by 2015 based on 2003 levels through a number of energy efficiency and renewable energy activities. The implementation plan for this order, the *State of California Green Building Action Plan*, directs state agencies to evaluate on-site clean energy generation opportunities.

The Department of General Services is coordinating efforts to meet the goal of the 2004 executive order. Since 2006, the department has directed installations of a combined 4.2 MW of PV system capacity. Electricity generated by these systems is transmitted directly to state facilities under a solar services model agreement with the local utility, which owns and maintains the systems. The state is currently planning installations of an additional combined 23 MW of PV capacity beginning in 2008. Overall, the state estimates that implementing the strategies described in the *Green Building Action Plan*, including developing on-site renewable energy resources, will reduce the state's CO2 emissions by 500,000 metric tons by 2010, increasing to 1.8 million metric tons by 2020 (California, 2001; California, 2004a; California, 2004b; California DGS, 2008; DSIRE, 2008).

Web site: ***http://www.green.ca.gov/factsheets/default.htm***

HAYWARD, CALIFORNIA —SOLAR ELECTRICITY GENERATION AT A UNIVERSITY

California State University at Hayward received the 2004 Green Power Leadership Award for installing the largest solar electric system at any university in the world. The 1 MW system, which is installed on four of the university's largest buildings and covers more than 110,000 square feet, is capable of supplying approximately 30% of the campus' peak energy demand during the summer months. The project was enabled by a rebate offered by the state Public Utilities Commission for $3.55 million — half of the cost of the project. The remaining $3.55 million will be financed over 15 years using the energy cost savings generated by the project, which is expected to total approximately $200,000 annually. The project is expected to reduce the university's CO2 emissions by nearly 8,900 tons.

Sources: U.S. EPA, 2007p; Energy Services, 2003.

Massachusetts – Renewable Energy Initiatives

In April 2007, the governor of Massachusetts established a goal for the state to achieve 250 MW of combined solar PV capacity by 2017. As a first step towards achieving this goal, the governor created *Commonwealth Solar*, an initiative to provide rebates to residential and commercial electricity customers who invest in PV technology. The initiative is expected to produce more than 27 MW of PV capacity by 2011. At this time, the governor also issued an executive order on state government *Leading by Example – Clean Energy and Efficient Buildings*, which established a goal for state agencies to obtain 15% of their electricity from renewable resources (including green power purchases and on-site generation) by 2012, increasing to 30% by 2020.

To help state agencies evaluate their PV capacity, the state Executive Office of Energy and Environmental Affairs' *Lead by Example* program has developed a site selection survey that enables agencies to conduct PV feasibility assessments for their facilities. A clean energy committee within the Executive Office of Energy and Environmental Affairs, including members of the Division of Energy Resources, the Division of Capital Asset

Management, and the Operational Services Division, is providing state agencies with technical assistance in achieving the governor's renewable energy goals.

Web sites: ***http://www.mass.gov/dep/energy.htm*** **(Renewable Energy Programs)**

http://masstech.org/solar/ **(Commonwealth Solar Initiative)**

http://www.mass.gov/envir/Sustainable/documents/pv_site_selection_survey.doc **(Feasibility Assessment)**

Illinois – Environmental Protection Agency CHP Activities

Since 2002, the Illinois Environmental Protection Agency has been providing technical assistance and support for CHP projects throughout the state. The agency, a partner in the EPA CHP Partnership, provides local governments, businesses, and institutions with assistance in identifying existing CHP projects and resources and developing future potential CHP applications. The agency has worked with the Midwest CHP Application Center and the University of Chicago to develop the 2003 *Illinois CHP/BCHP Environmental Permitting Guidebook*, which presents guidance for expedited permitting for CHP applicants in the state. The agency was also represented on a steering committee that led the first statewide CHP conference in 2002. On a regional scale, the agency works through the Midwest CHP Initiative to promote CHP throughout the Midwest.

Web site: ***http://www.chpcentermw.org/07-02_il.html***

Madison, Wisconsin – Combined Heat and Power at a University

In 2003, the governor of Wisconsin announced a public-private partnership to build a CHP plant near the University of Wisconsin-Madison campus to provide 150 MW of power and meet the space heating/cooling needs of the university's facilities. The CHP plant, which became operational in 2005, can achieve 70% efficiency and reduces energy consumption (compared to separate heat and power systems) by 10% to 15%. The CHP plant reduces NO_x emissions by 80% and CO_2 emissions by 15%.

The state Department of Administration worked with a private electric utility to design a facility that meets the university's needs, provides reliable power for residential and commercial businesses in the area,

CHP AT A WASTEWATER TREATMENT FACILITY (WWTF)

The Albert Lea Municipal WWTF takes a normal waste product–methane–from anaerobic digesters that treat the water and uses it to fuel their CHP system to provide thermal and electric power onsite. The WWTF uses four 30 kW microturbines to generate 120 kW of electricity and 28 MMBtu of thermal energy per year, which is used for space heating and to heat the facility's anaerobic digesters. Installed in 2003, the $250,000 project has an estimated payback of four to six years.

Source: Midwest CHP, 2005.

CHP AT KENT STATE UNIVERSITY

Kent State University, a partner in EPA's Combined Heat and Power Partnership, has received the Ohio Department of Development's Award for Excellence in Energy, as well as the 2007 ENERGY STAR CHP Award for its operation of two generators that supply both power and heat to the University.

The generators combine to supply 13 MW of electricity, matching nearly 90% of the university's electricity in winter months and about 60% of the university's electricity in summer months. Steam recovery units installed with the generators capture 60,000 pounds of steam per hour to be distributed to campus facilities, providing for 55% of the school's heating demands.

The system operates at 71% efficiency and achieves a 19% energy consumption reduction compared with separate heat and power systems. EPA estimates that the system reduces CO_2 emissions by approximately 13,000 tons annually.

Sources: Kent State University, 2005; Kent State University, 2007.

CHP AT THE UNIVERSITY OF TEXAS-AUSTIN

Since 1998, campus space at the University of Texas-Austin has increased by over 2 million square feet and energy demand has increased by more than 8%. However, due to the university's continual investment in CHP, fuel consumption since that time has increased by only 4%.

The most recent addition in 2004 included expansion of an existing natural gas-fired combustion turbine and heat recovery steam generator system. With the installation of a 25 MWe (megawatts-electric, often distinguished from megawatts-thermal in CHP applications) steam turbine, the renovated system produces up to 61 MWe of electricity, 280,000 lb/hr of steam, and 150,000 lb/hr of boiler feedwater. The steam and hot water are used for space heating, space cooling, domestic hot water, boiler preheat, and process steam in 160 campus buildings.

To maximize efficiency and overall performance, the system uses operational management software developed by Lightridge Resources. With an estimated operating efficiency of 60%, the University of Texas at Austin's CHP system requires approximately 24% less fuel than typical onsite thermal generation and purchased electricity. Based on this comparison, the system reduces CO2 emissions by an estimated 136,000 tons per year.

Source: U.S. EPA, 2007o.

and produces fewer emissions than conventional heat and power systems. The department negotiated with the utility to include the CHP plant development in a package of clean energy projects that also included installing 37 PV fixtures on campus. In addition, the utility agreed to provide additional fuel discounts to the state that could yield savings approaching $100 million over 30 years (Wisconsin, 2007c; MGE, 2008).

Web site: ***http://www.mge.com/about/powerplants/cogen/***

2.6 OTHER ENERGY SAVING OPPORTUNITIES

Many states are leading by example by implementing other energy and environmental activities that complement the LBE activities described in the preceding sections. While not always directly intended to reduce energy consumption, these activities can have secondary energy saving benefits. This section describes four of these activities.

CONNECTICUT DEMAND RESPONSE PROGRAM

In Connecticut, the state Office of Policy and Management (OPM) administers a Demand Response Program that coordinates demand response activities of eleven state agencies. OPM works with the agencies to reduce peak electrical loads during period of high demand by transferring loads to distributed generation equipment and reducing non-essential electrical loads. As compensation for reducing peak loads, which enables the regional grid operator to avoid installing additional infrastructure that would be needed to meet demand, OPM receives approximately $300,000 quarterly from ISO New England, the grid operator, through third-party contractors. This payment is allocated to the participating agencies for reinvestment in clean energy projects.

Source: Connecticut OPM, 2008.

MASSACHUSETTS STATE SUSTAINABILITY PROGRAM

Recycling is a cornerstone of the Massachusetts State Sustainability Program. In 2004, the state adopted a goal of achieving a government recycling rate of 50% by 2010. Accomplishments under this program include:

- Between FY 2000 and FY 2002, the Operational Services Division collected 2.8 million feet of fluorescent lamps, 4,000 other mercury-containing lamps, 350 pounds of elemental mercury, and 160,000 pounds of batteries.
- The Bureau of State Office Buildings Office Paper Recycling program recycled 640 tons of paper in FY 2002, saving over 10,000 trees.
- The Department of Environmental Management placed 15 recycling containers next to the dumpsters at the beach entrances and heavy-use areas to mitigate contamination from improper disposal of non-recyclable materials. About 2,400 pounds of material were collected with average contamination rates reduced to 1%.

Sources: Massachusetts, 2004; Massachusetts, 2007c.

2.6.1 DEMAND RESPONSE

Demand response refers to changing electricity usage from normal consumption patterns in response to change in the price of electricity over time. This often involves changing electricity use patterns in response to utility incentive payments designed to reduce demand during times of peak energy use or other times when electricity system reliability is uncertain. Participating in utility demand response programs can be an effective way to achieve energy system reliability benefits and reduce energy costs, and several states are saving energy costs by incorporating demand response activities as part of a strategic approach to energy management.

In 2004, the governor of California issued an executive order directing state agencies to reduce energy consumption in advance of private electricity customers during electrical emergencies, to help protect energy system reliability. As part of this mandate, the order directs agencies to work with electric utilities to coordinate agency responses to electrical emergencies and to participate in utility-based demand response programs (California, 2004a; California, 2004b).

2.6.2 REDUCING SOLID WASTE AND RECYCLING

Considerable quantities of energy are consumed to manufacture everyday products, such as office paper, computers, and ink toner cartridges. Using products made from recycled or renewable materials through non-energy-intensive methods can prevent unnecessary depletion of natural resources and reduce the energy required to manufacture new products and

RECYCLING – ENERGY RELATIONSHIP

- Recycling one pound of steel saves 5,450 Btu of energy, enough to light a 60-watt bulb for over 26 hours.
- Recycling one ton of glass saves the equivalent of nine gallons of fuel oil.
- Recycling aluminum cans requires only 5% of the energy needed to produce aluminum from bauxite. Recycling just one can saves enough electricity to light a 100-watt bulb for 3½ hours.

Source: Pennsylvania, 2007.

dispose of used ones. Diligent recycling can conserve 70% to 90% of the energy required to produce products from virgin materials. The amount of energy saved from recycling one ton of office paper or one ton of aluminum cans is equal to 10.2 million Btu and 206.9 million Btu, respectively (Choate et al., 2005).

Most states administer programs to purchase recycled-content products and collect used products to be recycled. In 2005, North Carolina state agencies purchased $12 million in recycled-content office paper. This effort conserved 115,000 trees, saved enough energy to supply nearly 900 homes for a year, and reduced CO_2 emissions equivalent to removing 915 cars from the road for a year (North Carolina DENR, 2005). In Florida, the state office recycling program recycled nearly 235 tons of white paper—34% of all paper used—over two years. In addition to avoiding 700 cubic yards of solid waste, this effort saved the state nearly $7,000 in fees for hauling the garbage and earned the state more than $9,000 in sales of the salvaged materials (Florida, 2004). In 2005, state government recycling efforts coordinated by the Pennsylvania Department of General Services generated $32,000 in salvaged paper sales and $546,000 in salvaged metals sales (GGGC, 2008). In Minnesota, 21 of the state government's largest buildings have joined the State Agency Recycling Challenge in an effort to achieve a 60% recycling rate in each agency. In the month of February 2007 alone, these buildings combined to save approximately 200,000 pounds of recycled material (Minnesota RRP, 2007.).

2.6.3 WATER EFFICIENCY

The conveyance, treatment, distribution, and end-use of water, along with the treatment of wastewater, require a significant amount of energy. The energy required to pump purchased water for end use is approximately 0.6 kW per 1,000 gallons distributed (Universities Council on Water Resources, 1999). According to a 2008 EPA report on the relationship between water and energy use, it is estimated that water supply and wastewater treatment nationwide require 30 billion kWh per year and 7 billion kWh per year, respectively — approximately 1% of total annual U.S. electricity generation at a cost of $3 billion (U.S. EPA, 2008u).[19] In California, where the energy intensity of water conveyance and treatment is high, water-related energy use constitutes 19% of the state's annual energy use and 32% of its annual natural gas use (CEC, 2006).

At the system level, increasing the energy efficiency of system operations (e.g., through process improvements, use of efficient pumps and motors) and shifting discretionary uses of energy to off-peak times (e.g., by increasing water storage capacity) can reduce energy consumption. Energy efficiency measures can reduce energy consumption in most water systems by 25% (Watergy, 2002). In New York, NYSERDA encourages

EPA WATERSENSE LABEL

The EPA WaterSense Program labels products that meet water efficiency and performance criteria. Labeling criteria have been established for plumbing fixtures (e.g., toilets and sink faucets), landscape irrigation equipment, and other commercial products. In general, products that receive the WaterSense label are 20% more water-efficient than conventional products.

Source: U.S. EPA, 2007b.

MASSACHUSETTS WATER CONSUMPTION REDUCTION GOAL

Some states have taken the initiative of setting goals for reducing state government water consumption. Massachusetts, for example, has a goal of reducing water consumption by 15% in state agencies by 2010. The state plans to achieve this objective by taking cost-effective steps such as reducing outdoor water use through green landscaping techniques, replacing old fixtures, inspecting and repairing leaks, and identifying options for using reclaimed water.

Source: Massachusetts, 2004.

COLORADO WATER CONSERVATION ACTION STEPS FOR STATE AGENCIES

The Colorado Greening Government initiative developed a list of action steps for state agencies to reduce water consumption, including:

- Implementing water efficiency awareness programs.
- Reducing non-essential water uses, including vehicle washing, decorative fountains, and routine athletic field watering.
- Focusing on restroom water use, which can account for as much as half of total water demand, by:
  - Replacing old toilets that use 3.5 gallons per flush (gpf) with 1.6 gpf units.
  - Installing water-saving aerators on faucets.
  - Installing pressure-reducing valves to reduce consumption.
- Limiting allowed watering hours to times when evaporation is lowest (i.e., early morning or later in the evening).
- Planting drought-tolerant native plants.
- Eliminating once-through cooling systems.

Source: Colorado, 2005.

[19] *For more information, see EPA's 2008 report, Water and Energy: Leveraging Voluntary Programs to Save Both Water and Energy at* ***http://www.energystar.gov/ia/partners/publications/pubdocs/Final%20Report%20Mar%202008.pdf.***

municipal water, wastewater, and solid waste treatment facilities to adopt energy-efficient practices through cost-sharing research, business development programs, and demonstrations (NYSERDA, 2004b).

At the facility level, states can improve indoor water efficiency by installing water-efficient fixtures (e.g., toilets, faucets). Installing water metering and monitoring systems, for example, can reduce energy consumption by up to 10% (Watergy, 2002). Exterior water consumption reduction strategies include:

- Collecting and using rainwater for landscape irrigation.
- Planting roof areas to reduce loss of storm water.
- Increasing reliance on native plant species that are adapted to the local environment, which can increase water efficiency by as much as 50% (U.S. DOE, 2006l).
- Altering irrigation schedules to reduce peak demand (U.S. EPA, 2002).

Some states have reduced exterior water consumption through a technique called xeriscaping that replaces water-intensive landscaping materials with locally adapted plants, shrubs, mulch, and other materials. Xeriscaping efforts at the Colorado State Laboratory are expected to save more than 780,000 gallons per year, reducing maintenance costs by an estimated $4,000 annually (Colorado, 2006b). Legislation in Florida and Texas requires that the state departments use xeriscaping practices on certain new state construction projects (U.S. EPA, 2002).

2.6.4 TREES AND VEGETATION

Trees and vegetation and responsible landscaping practices can significantly reduce energy consumption by moderating exposure to sun and wind. In general, large trees or bushes planted close to a building's side will produce substantial energy savings, although benefits vary based on orientation, size, leaf cover, and distance of trees and vegetation from a building.

According to EPA, to achieve maximum cooling savings, deciduous trees should be planted to the east, southeast, southwest, and —especially —the west of a building to shade wall exteriors (U.S. EPA, 2003b).[20] A joint study by LBNL and the Sacramento Municipal Utility District placed varying numbers of trees in containers around houses to shade windows and then measured their energy use (Akbari et al., 1993). Cooling energy savings ranged between 7% and 40% and were greatest when trees were planted to the west and southwest of buildings. Another study by LBNL, which modeled the effects of trees on homes in various cities throughout the United States, suggests that a 20% tree canopy would result in annual cooling savings of 8% to 18% and annual heating savings of 2% to 8% (Huang et al., 1990).

Trees and vegetation can also reduce winter heating costs by shielding wind. Trees and large bushes, particularly evergreens, planted to the north or northwest can serve as windbreaks and protect buildings from cold winter winds. One study indicates that properly placed wind-shielding trees can produce heat energy savings of 10% to 15% (LBNL, 2005).

The presence of trees and smaller vegetation in the urban environment can also provide energy benefits during the summer months through evapotranspiration —the process through which trees and vegetation absorb water through their roots and emit water vapor through their leaves. Different species of trees can process varying amounts of water, ranging from a few gallons a day up to several thousand gallons a day. In combination with shading, evapotranspiration can reduce peak summertime air temperatures by as much as 9°F in some regions, which can translate into significant energy cost savings (U.S. EPA, 2007m).

[20] *Planting trees to the direct south, however, should generally be avoided, since these trees will provide relatively little summer shade and will obstruct desired winter sunlight (U.S. EPA, 2007e).*

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TABLE 2.6.1 CHAPTER 2: POTENTIAL LBE ACTIVITIES AND MEASURES: SELECTED RESOURCES

Title	Description	URL
Databases		
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/*
DOE State Energy Program	DOE's State Energy Program (SEP) provides grants to states and directs funding to state energy offices from technology programs in DOE's Office of Energy Efficiency and Renewable Energy.	*http://www.eere.energy.gov/state_energy_program/topic_definition_detail.cfm/topic=115*
Best Practices Resources		
EPA ENERGY STAR Building Upgrade Manual	EPA's ENERGY STAR Building Upgrade Manual provides information on implementing a staged upgrade approach to improving energy efficiency in buildings.	*http://www.energystar.gov/index.cfm?c=business.bus_upgrade_manual*
EPA Clean Energy-Environment Guide to Action	EPA's Clean Energy-Environment Guide to Action is designed to share the experiences and lessons learned from successful state clean energy policies and help states evaluate these options, programs, and policies to determine what is most appropriate for them. The Guide to Action describes 16 clean energy policies, details the best practices and attributes of effective state programs, and provides resources for more information.	*http://www.epa.gov/cleanenergy/energy-programs/state-and-local/state-best-practices.html*
EPA Clean Energy-Environment State Partnership Program Technical Forum	EPA's State Technical Forum conference calls foster peer-to-peer exchanges among state officials on policy design, implementation, and evaluation issues related to their efforts to advance clean energy	*http://www.epa.gov/cleanenergy/energy-programs/state-and-local/state-forum.html*
EPA ENERGY STAR Guidelines for Energy Management	EPA's Guidelines for Energy Management are based on the successful practices of ENERGY STAR partners. The Guidelines for Energy Management for energy management assist organizations in improving its energy and financial performance.	*http://www.energystar.gov/index.cfm?c = guidelines.guidelines_index*
National Governor's Association Center for Best Practices	NGA's Center for Best Practices evaluates public policy innovations and ensures that all governors are aware of these advances by Publishing research reports, policy analyses, issue briefs, and a variety of other materials on timely issues. The center also Hosting policy workshops, seminars, academies, and cross-state learning labs across the country	*http://www.nga.org/portal/site/nga/menuitem.50aeae5ff70b817ae8ebb856a11010a0/*

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