

The Role of State Programs in Promoting New Energy Efficient Technologies

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ABSTRACT

State government can play a decisive role in the adoption of new energy efficient technologies by requiring, encouraging, or assisting organizations to make the change. This paper will review examples of recent state government activities in Wisconsin that promoted energy efficient technologies. Some activities targeted state agencies operations directly, such as overhaul of building design specifications for state agency projects, procurement innovations in contracts and purchases, and early discretionary adoption of high efficiency technologies by facility managers at state agencies and land-grant universities. State government also had influence beyond their own operations by sponsoring cooperative purchasing agreements with local governments, procurement assistance for private non-profits operating government-funded programs, new technology requirements and preferences in government-assisted housing programs, and training and demonstrations.

Technologies with an existing foothold in the market, such as ENERGY STAR-labeled products, have gained market share through high volume state purchasing and other efforts. For example, low-income weatherization and other government and utility programs played an important role in the transformation of the market for condensing furnaces in Wisconsin. Less mature technologies with very low market penetration such as LEDs also benefited from state efforts such as demonstration or pilot projects. State commitments to these technologies helped bridge the “*valley of death*” in technology commercialization. Authors review results of Wisconsin’s state efforts to date to promote condensing boilers, direct vent water heaters, residential furnace ECMs and ventilation fans, ENERGY STAR freezers, LCD or flat-screen monitors, high performance T-8 lighting, high color temperature lighting, specialty CFL lighting and recycling of CFLs, and LED holiday lights. Lessons learned are widely transferable to other states.

Introduction

State government has a unique role to play in the promotion and acceptance of energy efficiency. Government agencies are themselves large organizations that demand a high volume of operational goods and services, and often purchase for local governments, making the state government one of the most influential buyers in the market. State government also needs a wide range of technologies, equipment, and appliances with various operating characteristics. Furthermore, state government has the ability to monitor, test and evaluate the performance of new equipment and verify claims of enhanced performance. Personnel resources in state government include engineers, architects and policy makers with a broad range of talent and expertise. These personnel frequently act as mentors, promoters, sponsors and champions of new technologies. Vendors frequently provide information on new products such as LED street lights,

parking lighting, or light bulbs. State staff can then test products, such as circular polarization lighting filters, and determine whether they are effective (they were not in this case). This helps professionals in state government become more aware of the newest technologies.

Also, state government provides funding directly and indirectly for a wide range of programs. Finally, state government oversees a large fleet of buildings, and is responsible for the design, building and retrofitting of state government facilities. In Wisconsin for example, state government is the largest owner of real estate within the state. The state also leases a considerable amount of building space.

Government operates with different timelines and budget constraints than other sectors of the economy. One of the unique characteristics of state government is that even when the economy enters a downturn, government buildings continue to be designed, built and retrofitted. Even in lean times, governments continuously stimulate the private sector by building or replacing equipment. State government has a permanent mission and permanent commitments. Hence they can look further into the future to justify their decisions. Also, government is not profit seeking, and seldom needs to show a monetary return on program investment. As a result state governments can accept longer payback periods than the private business sector can. Unlike private enterprises, state government programs do not have an incentive to hold back money for shareholders or reinvestment, but generally spend all the funds allocated for a project or program to reduce the risk of getting less than requested for the next project.

State government has several directives to support efforts toward energy efficiency. In 2005 Wisconsin's Act 141 established new requirements for the state for energy efficiency and buying renewable energy (WLC 2006). In 2006 Executive Order 145 addressed state agency operations particularly (WOG 2006). This order established energy efficiency goals for agencies, a 10% reduction in energy use per square foot by FY08 and 20% reduction by FY10. Another goal is for new state government facilities to be designed to be 30% more energy efficient than code. In addition, the order directs adoption of Sustainable Building Operation Guidelines, including benchmarking and annual reporting for state government buildings.

Roles for Government in Promoting Energy Efficiency

Demonstrations

Another role that state government programs play is to serve as a demonstration site for new products and concepts. For example, the Division of State Facilities recently tested the use of occupancy controllers for lighting in non-traditional areas: underground parking garages and stairwells. Occupants adjusted well to the change, providing substantial energy savings. Another technology tested recently was CFL replacements for MR-16 halogen pin-based lighting. This test was only partly successful. State staff are following up with the manufacturer to determine why some bulbs failed early.

Many state government demonstration sites are accessible to the public and other interested parties. The State Capitol Building, one of the most often visited tourist sites in the state, is a demonstration site for ENERGY STAR light bulbs. The State Capitol is a historic building surrounded by decorative illumination on outdoor vertical standards. Originally, the lighting consisted of 100 watt incandescent bulbs in each of the 196 outdoor decorative globe fixtures. These lights are on approximately 12 hours each day of the year, summer and winter (6 PM to 6 AM). A few years ago, the 100 watt incandescent lamps were replaced with 4 watt CFLs

with 4100K color temperature. The lighting performed well in Wisconsin's cold winter weather and provided light acceptable to building managers and visitors. The demonstration illustrated that many CFLs are now rated for cold weather use, down to -5 degrees F, or even -20. In this demonstration, the longer 8,000 hour lifetime for the CFL (compared to the 750 hour lifetime for the incandescent bulb) provided another benefit: less likelihood of a bulb burning out, reducing the need to disassemble outdoor fixtures in winter conditions for bulb changing.

Facilities staff has installed about 3,200 CFLs, both inside and outside the Capitol Building. Also, the Capitol's large annual holiday tree uses LED holiday lights. The Governor's Executive Residence is another demonstration site. After installing 254 ENERGY STAR light bulbs in 2007, it is estimated the residence will save over 17,000 kWh per year and reduce their electric bill by over \$1,200. Recently facility managers installed another 80 decorative cold cathode CFLs, effectively eliminating inefficient incandescent lighting from the residence.

Education and Awareness

As a large and pervasive organization, state government can promote awareness of energy efficient technologies throughout many sectors of the economy. The state can set an example for other organizations to follow. For example, in its role as a large employer, the state provides a path for other employers to follow. Recently several state agencies in Wisconsin sponsored work-place CFL light bulb sales events for their employees. By hosting the sale, the agencies sent the signal to their employees that their home lighting decisions were important to the whole community, and that CFLs deserved special attention. Other employers have hosted similar sales for their employees.

Another example is the "We Conserve" campaign at the University of Wisconsin Madison (UW 2008). This campaign hung large outdoor placards on university buildings and trucks. The campaign's provocative slogans have received considerable attention. Slogans include "Wants or Needs?" and "Who Cares" (with no punctuation).

The State Facilities office played an educational role for building professionals in 2006 when it organized an all-day workshop to roll out new guidelines for high performance T8 lighting in state projects. Attendance at the workshop was boosted by offering a webcast of the session. Private sector lighting designers and engineers throughout the state participated in large numbers. By educating the lighting design and contractor industry on state agency expectations for future lighting, the state had an effect on the knowledge base of the entire industry. This carried over to private sector projects.

Regulation

State agencies often serve an energy-related regulatory role. This role can directly or indirectly promote energy efficiency in buildings. For example, the state grants licenses for professionals, including HVAC officials and real estate agents, etc. The state plays an important role in establishing building code changes and in the enforcement of those codes. Usually codes do not drive the leading edge of energy efficiency, but in some states such as California, they can. Another opportunity for promoting energy efficiency occurs when the state health agencies review operations and building plans for hospitals and nursing homes. In each of these instances, energy efficiency can be a consideration in the work of the agencies.

Mechanisms of State Government – Three Important Examples

Design Guidelines

The state of Wisconsin articulates its overall directions for new construction projects and major retrofits in its Design Guidelines. These guidelines provide architectural and other direction for projects of the agencies and University of Wisconsin. Recently, the state has augmented its Design Guidelines with special Sustainability Guidelines, based on the LEED criteria from the U.S. Green Building Council. These guidelines incorporate sustainable design principles and subsume existing guidelines in particular areas, such as the state's daylighting guidelines for its own buildings, which are more prescriptive than LEED. The Sustainability Guidelines address principles and practices that the Design Guidelines did not address formally in the past, such as green cleaning practices and compounds. An important principle in the guidelines is the three R's of Reduce, Reuse and Recycle. The retrofit of existing facilities provides both an opportunity and a challenge: reducing the waste produced and reusing or recycling items such as lighting fixtures, office equipment and office furniture. The state is poised to incorporate these new practices on a large scale.

Master Specifications

After the Design Guidelines, the next level of specificity in implementing these guidelines is found in the state's Master Specifications. These specifications establish energy performance requirements for specific equipment types. These Master Specifications have an influence on many building professionals in the state. The Wisconsin Division of State Facilities contracts with the private sector for the design and construction of new buildings and major retrofit of existing buildings for state agencies. Furthermore, the state's lease requirements for new space or renewal of currently-leased space can have an impact on hard to reach building sectors.

The Master Specifications often adopt energy efficiency guidelines well in advance of the general building industry. For example, the Master Specifications require High Performance T8 Lighting and high color temperature 5,000 degree Kelvin illumination for both T-8 lighting and pin based down-lights (CEE 2008). Wisconsin's Master Specifications also forbid the use of incandescent lighting in its projects (WDOA 2008).

Procurement

When state government specifies or begins to incorporate new products into what they buy, they have the ability to drive the price down for themselves but also for all consumers, thereby increasing the market for new products (Harris et al. 2004; Mapp, Bair & Smith 2006). Government acts as a specifier not only for products it buys directly, but also for products purchased by many other organizations that implement government-funded programs. The state can drive energy efficiency through its volume purchase of energy efficient goods and services. State governments purchase a wide range of different commodities and services, and recently there has been a movement toward incorporating Energy Star or other nationally recognized efficiency guidelines into the bid specifications for supplies, equipment or services. Rather than specifying a particular efficiency level, procurement agents are encouraged to require "Energy

Star” explicitly as an integral component of the bid specification. This promotes suppliers’ understanding of the energy efficiency requirement and assures that the energy efficiency level will always move up automatically as the Energy Star guideline evolves. When absolute efficiency levels are specified instead, there is a tendency for these specifications to be copied on future bid documents, locking in efficiency levels at a historically artificial level.

The procurement principle of competition often is in conflict with a desire for high quality products that may cost more. Generally state statutes require that goods and services be obtained from the lowest bidder. However, lifecycle costing is allowed. Lifecycle costing encourages the installation of energy efficient equipment because of the long term savings. However, using lifecycle costing is not always practical. Results of lifecycle costing are dependent on input assumptions such as discount rates, escalation rates for energy prices, and equipment lifetime. Another concern is how Non-Energy Benefits (NEBs) are incorporated, such as reduced maintenance costs, safety and health, and disposal costs.

It would be ideal to use the principle of lifecycle costing while avoiding an arduous evaluation for each individual bid. Relying on national guidelines for energy efficiency can often achieve this, guidelines such as Energy Star, FEMP, NEMA, ARI and ASHRAE. Frequently the federal government or industry groups developed these guidelines after a detailed study of the long-term costs and benefits of energy efficiency for a particular equipment type. Now buyers can rely on these results without repeating the calculations for each bid. Official orders to specify energy efficiency can overcome purchasers’ reluctance. In Wisconsin, Executive Order 145 has provided additional justification for using these nationally recognized guidelines as specifications for goods and services.

A seldom-mentioned aspect of state government programs is the development of a network of minority vendors. Minority vendors are allowed to have a 5% higher price on the goods and services they provide. Thus they can be the successful bidder for slightly more expensive, energy efficient products. They can also be encouraged to carry more expensive products that can lead to their gaining market advantage through being the first qualified distributor.

Competitive procurement can inhibit energy efficiency in another way. Competitive procurement procedures often require three or more vendors. There is still some challenge in bringing new products into the supply chain if there are not sufficient players in the market. A recent example is the attempt to find three manufacturers of LED Street Lights. Wisconsin purchasing agents aim to launch a bid specification for this product by December 2008.

To overcome these barriers, purchasing agents can work with state engineers to test new technologies through samples received from vendors or incorporated into bid specifications in the procurement process. Procurement officials can also revise cost benefit analyses by incorporating the value of Non Energy Benefits (NEBs) such as lower maintenance cost or reduced recycling cost. Another option is to revise cost effectiveness tests to value energy at market prices, value greenhouse gas reductions, or revise discounting approaches. New legislation requiring use of Sustainable Products can facilitate procurement specifications that include or encourage new technologies.

Examples of the Power of Volume Purchasing and Specification

Here are some examples of how state agencies and state programs are driving the purchasing of energy efficient products. Wisconsin state agencies are volume purchasers of ENERGY STAR office equipment and computers, and high performance T8 lighting (especially scotopic lighting). The state is also early adopter of ENERGY STAR commercial kitchen equipment, such as ovens.

The state drives efficiency even in residential-type products. The University of Wisconsin is a high volume purchaser of ENERGY STAR room air conditioners for the university, and also buys a fair number of dorm-sized refrigerators. The state housing office includes requirements for Energy Star on equipment purchased with its grants to homeless shelters and other grantees (WDOC 2008). The agency that allocates federal tax credits for affordable multi-family housing in Wisconsin includes requirements for Energy Star equipment and other energy efficiency features for developers who wish to receive a tax credit (WHEDA 2007). Through the low-income weatherization program, the state facilitates the large-scale purchase of ENERGY STAR refrigerators and freezers and CFLs, and other products (WAP 2008; Smith & Mapp 2006).

The state's history of promoting condensing furnaces through the low income weatherization program shows how the process can work. About 20 years ago, the Wisconsin program began to install these furnaces although condensing units had only a small portion of the market. The program drove a demand for a large number of condensing furnaces. Contractors had to revise their stocking practices to carry more units. The contractors gained confidence that the units were reliable, and this increased availability. Contractor confidence drove down the price. Large scale installation of condensing furnaces resulted in the identification of models that had operational or design problems, in some cases resulting in early or premature failure. These models lost market share. The total installed cost for a condensing furnace began at about \$2,600 and fell to about \$2,100 over the course of several years, partly due to the state's role in promoting them through weatherization. High efficiency condensing boilers may follow a similar trajectory as the state promotes these through weatherization. Currently the program provides for installation of both 80% and 90% condensing furnaces depending on the project's Savings to Investment Ratio (SIR). As the program gains experience and drives down the price, the goal is to move exclusively to condensing boiler installations.

The Wisconsin weatherization program targets households of up to 150% of poverty and has a goal of reaching 10,000 residences a year, and funds direct install of Energy Star light bulbs in all the sockets of the homes they weatherize, inside and outside. Currently the program is reaching about half the sockets in each home, 20 sockets for a single family home and 13 for multi-family. A similar program in California targeted to households of up to 200% of poverty estimates that even though two of the 17 fixtures in a typical low income home already has CFLs, there is potential to install 10 additional CFLs in every low income home (4 million households, 28% of the population) (Gaffney 2007). This gives a sense of the scope of the opportunity that could be fulfilled by state-directed programs. The state is assisting local weatherization agencies to procure Energy Star lighting through economical bulk buying. As an example of the results possible, the UW recently purchased 20,000 CFLs, at a price of \$1.55 per 15w CFL (60w equivalent).

Another example is a recent RFP for several hundred dorm-sized refrigerators for a branch campus of the University of Wisconsin. By working with a leading vendor, the state assisted in getting the manufacturer to submit their unit for listing as an ENERGY STAR model.

This shows the important role that large purchasers can play in influencing manufacturers to participate in voluntary energy efficiency labeling programs.

Professionals in state government programs can also identify problem products. For example, in Wisconsin early electronic ballasts were a problem, experiencing high failure rate and higher than expected energy consumption. State staff was able to work with the manufacturers, to identify the problem and demand better products. The manufacturer modified the manufacturing and assembly process and was able to provide a superior, longer-lasting, more efficient product.

Examples of Promising Concepts and Technologies

Below are several examples of concepts and technologies that state governments can use to achieve greater energy efficiency.

Concept Examples

Renewable energy and net zero energy goals. A recent Wisconsin project aims to make four University of Wisconsin (UW) branch campuses independent of fossil fuel by 2015 (UWGB 2008; UWRF 2008; UWSP 2008). In practice this will mean deriving all their heat and electric needs from renewables, either generated or purchased. The state and UW leaders are still working on a plan to do this and so far leading approaches appear to be energy efficiency and purchase of wind. Also, the campuses will use switchgrass and wood pellets in heating plants that can be retrofit, and biodiesel in other plants. Solar thermal and PV will also play a small role. Two of the campuses already have solar hot water systems. Some of the renewable energy purchase agreements are already in place. One campus for example already purchases 40% of its electric energy from renewable sources. To achieve this project's goals for renewable energy at a reasonable cost, the state will have a strong motivation to implement aggressive energy efficiency.

The UW campus project above is an element of a larger state government program to purchase 10% of its electric consumption from renewable energy sources by the end of 2007 and 20% by 2011. The baseline is a three year average of the consumption of its five largest agencies and the UW.

Dark sky initiative. State government can play a role in saving energy while reducing light pollution. The International Dark Sky Initiative has guidelines and resources for designing lighting. These resources may be useful to states as they set requirements for illumination in parking areas, outdoor wall washer illumination and street lighting on state roads. The use of dark sky guidelines would provide an incentive for architects and contractors to become familiar with and incorporate these principles into their activities outside the state government sector as well.

Green building. Green building is a philosophy that is influential particularly among architects and the building design community. The U.S. Green Building Council's LEED requirements are implemented more frequently in the public sector than originally expected. Many organizations that adopt LEED guidelines avoid the full process of LEED certification, in favor of a self-enforced approach. Objections to the full certification include the cost of the third-party review,

the lack of credits appropriate for a cold climate, and disagreement over levels of ventilation. The state of Wisconsin has had a few successes overcoming this barrier. A new building for the Department of Natural Resources has achieved LEED-NC certification (WNDR 2008). The state has a goal of achieving LEED-EB certification for all its existing buildings. The strategy is to start with the buildings that are known to be better performers. The state is scheduled to pursue LEED-EB certification for its Department of Agriculture Building. The building already scores a 77 on the ENERGY STAR Portfolio Standard rating test, so this provides a platform on which to seek a LEED-EB rating.

Carbon credits. Concerns related to global warming, including possible carbon taxes or emissions cap and trade have increased interest in large verifiable energy savings as a way to enhance credit rating for a bonding authority and as a perceived value during times of economic constraints.

Technology Examples

Electric commutated motors (ECM) in natural gas and propane furnaces. In an effort to reduce electric expenses, many installations of high efficiency furnaces in Wisconsin now incorporate ECM motors. State programs related to housing can promote this technology. More support for ECMs would provide installation experience to contractors and fill supply channels, helping to drive down the installed price, improve the reliability of installation practices, and provide a better product at reduced prices to the general residential consumer.

Cold cathode CFL lamps (CCCFL). These lamps have very low market penetration but have several distinct advantages over other lighting. For example, they have an advertised lifetime of 24,000 hours. At three times the lifetime of typical 8,000 hour CFLs and 20 times the 1,500 hour lifetime of low wattage incandescent lamps, they are already price competitive with a \$5 CFL, at \$12.95 for a Cold Cathode lamp. As this technology captures more market share the price will come down even more.

Another unique feature is the dimmability from full brightness to very low levels of illumination. These bulbs also can be rapidly switched on and off. They have the potential for playing a large role in the decorative lamp market in residential chandeliers, hospitality establishments such as university unions or theater marquees with their need for frequent on off signage. Another advantage of CCCFLs are their availability in transparent flame tip bulbs. These decorative lamps can play a large role in historic buildings or in food service facilities. State government can play a role in promoting this new technology by installing them in public places with dimmable lamps, chandeliers, or wall sconces. Low income or housing programs can install CCCFLs where dimmable or decorative lamps are desired.

Lessons Learned

The lessons learned through observations of state government in Wisconsin are widely applicable to other states, as well as other organizations in the private and government sectors. Below is a brief discussion of some of these lessons.

General Lessons

Everyone wants to do what is right. Most people want to help the environment. Energy efficiency advocates just have to find a way to make them feel comfortable in doing something differently.

There is a tendency to criticize new technologies or techniques as having specific problems. This presents an opportunity for promoters of efficiency. Identifying these problems and finding a solution -- or demonstrating that there is not a problem -- enhances the credibility of the product or service. For example, concerns about mercury in CFLs have led to caps on the amount of mercury in the product, enhanced recycling efforts, and expansion of recycling of other mercury containing products.

Sustainability has become a very useful concept. It incorporates even older ideas such as the 3R's (Reduce, Reuse, Recycle), energy efficiency, and green. There are synergies between green practices such as recycling mercury in CFLs and promoting low energy use products.

Upgrading state government master specifications is effective. These specifications should rely on nationally recognized guidelines that can be relatively easy to implement. For example, requirements for products should reference Energy Star, FEMP, the New Building Institute, NEMA Premium, CEE High Performance equipment or other recognized guidelines. State adoption of these national guidelines can impact the general design, contracting and construction industry as well.

There is a great difference between how agencies deal with a maintenance budget item and a capitol budget item. Installing a large capitol improvement such as an HVAC system is a long and involved process. Modification of lighting systems to incorporate CEE High Performance T8 Lighting is much easier. It can be accomplished under a maintenance budget, using existing personnel. This is particularly true in going from three-bulb to two-bulb installations such as going from 60 to 90 lumens per watt because of the lower cost and carrying charge for fewer lamps.

The impact of state government is enhanced when there is a central authority for design and contraction, building operation and maintenance or procurement. This reduces the silo effect and provides for more uniform policy implementation.

Direction from a governor's executive order or legislation is helpful. This provides agencies cover, a comfort level, and can transplant back bone, to facilitate the introduction of new technologies and incorporation of energy efficiency into governmental operations.

Procurement Lessons

Modifying procurement specifications is important. State agencies can make particular headway in areas such as Energy Star office equipment. These specifications are easily implemented and transferable from one agency to another or from state to state.

Making state government procurement contracts available to other taxing authorities expands their effect. State government’s professional procurement staff and competitive bid process can establish good deals for buying energy efficiency products. By opening these contracts to other public organizations such as county and municipal governments, school districts, library districts, water and sewer districts, the volume of the contract increases, potentially lowering the bid price and enhancing the availability of energy efficient products for more buyers.

The requirement for three “qualified” bidders is not insurmountable for new products. For energy efficient products with only a few manufacturers, agencies often have difficulty finding enough bidders to make a competitive process. This obstacle can be overcome initially by requiring the product or service as a component of a larger project to be bid out. Agencies should require bids for the large project to identify the source of the required energy efficient product. Later procurement agents can use this information when bidding the general procurement contract.

Non-availability of energy efficient products may be rectified quickly. For example, a procurement process for a product such as dorm refrigerators may fail to produce bids for return Energy Star qualified models. State staff can approach each vendor who submitted a bid, to encourage manufacturers to modify products to go through the process of becoming Energy Star qualified.

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