Energy Efficiency Best Practice
Energy Efficient Residential Windows Program

Description

This initiative would encourage the use of high performance windows. Windows are usually addressed as part of a more comprehensive energy retrofit or new construction program. There is an opportunity to leverage the work of the National Fenestration Rating Council (NFRC) and the Efficient Windows Collaborative (EWC) to promote high performance windows.

The NFRC is a "non-profit, public/private organization created by the window, door, and skylight industries. It is comprised of manufacturers, suppliers, builders, architects and designers, specifiers, code officials, utilities, and government agencies. NFRC provides consistent ratings on window, door, and skylight products."[1] Because of the work of the NFRC, consistent labeling of windows is available in the market, making it easier for consumers and building professionals to compare the performance of windows.

The Efficient Windows Collaborative, funded by the Department of Energy Windows and Glazing Program, is an excellent resource for information on how windows perform, offering fact sheets, and other consumer education materials. The Efficient Windows Website is found at www.efficientwindows.org/.

Public Policy Rational

Inclusion of energy efficient features are more cost effective when included in new construction. There is an opportunity to work with industry to promote energy efficient windows through the NFRC and EWC, and to promote more comprehensive new construction and building retrofit programs. Windows can account for about 25 percent of the heating and cooling costs in a home, representing one of the most significant energy saving features of new buildings. Programs should, however, focus on a more comprehensive "systems approach" to buildings with high performance windows as part of a package of measures.

Examples of Implementation

- California recently required NFRC ratings on all site-built windows for nonresidential buildings with at least 10,000 square feet of glass and at least 100,000 square feet of floor area.
- Building America is an excellent example of the "systems approach" to building. Windows play a central role in the overall design of an efficient thermal envelope.
- Fannie Mae offers low-interest, unsecured loans up to $20,000 for energy efficiency improvements (including windows) to homes.
- Utilities have offered rebates for high performance windows (Boston Gas Company window rebates, 1998; Pacific Gas and Electric's 1-2-3 Cashback Program).

Political Feasibility

Current programs available in the window/door industry offer opportunities for partnerships to further the introduction of high performance windows in new construction. Performance standards for windows are imbedded in the new International Energy Conservation Code that is being adopted or considered in several western states.

Summary of Costs and Benefits

Higher performance windows are gaining market share as the public becomes more aware of the comfort and energy benefits. These benefits are:

- ?? Energy and cost savings

?? Comfort

?? Fewer condensation problems

?? Increased light and view

?? Reduced fading of interior fabric

?? Smaller heating and cooling systems

Cost is dependent on the market and will be higher in areas where the market has not yet demanded the improved performance windows. For a typical home, high performance windows may cost 20 percent more than standard double-pane windows. In some regions, however, market demand has all but eliminated anything other than low-e windows and therefore any significant cost impact.

Windows are much more cost-effective in new construction than as a replacement strategy when looking strictly at energy savings. However, several of the other benefits mentioned can drive the replacement market.

Regional Coordination/Interaction with Other Policies

An effort to integrate high performance windows with other energy efficiency programs is beneficial. If energy codes are proposed as one of the implementation strategies, this should be done as a coordinated effort in large metropolitan areas (in states with no state energy code) to ensure consistency for the building industry.

Required Action

The adoption of the IECC can set window standards at a level that improves building performance without excessive cost burden. In lieu of code options, the window/door industry has credible, user-friendly educational tools that should be better utilized to raise public awareness of the benefits of efficient windows.

Rebates and/or low-interest loans for high performance windows can be effective market stimulators. However, energy efficient windows are generally recommended as part of a comprehensive package along with sizing of heating and cooling systems.

[1] Description from the National Fenestration Rating Council

Energy Efficiency Best Practice
Residential Weatherization

Description

This measure would work to significantly increase the energy efficiency of dwellings while reducing energy costs and safeguarding the health and safety of residents. Services should be provided by professionally trained crews or contractors, using advanced energy audits and diagnostic equipment to identify cost-effective, energy-saving improvements for each home. Examples of improvements include but are not limited to: installing insulation, reducing air leakage, performing combustion appliance safety checks and efficiency modifications, cooling system charging and modifications, water heating system improvements, electrical base-load reduction improvements, and window and door improvements.

All categories of residential building types could be addressed, including single-family detached homes; mobile and manufactured homes; and multi-family homes including row houses and multi-storied buildings.

Public Policy Rational

Weatherization programs are typically, but not exclusively, focused on lower-income residents, those for whom higher energy bills have a more significant economic impact. Basic comfort in an inefficient structure can be a costly proposition, and health and safety are also issues that enter the mix with lower income residents. Lowering energy costs for these residents have added community benefits (i.e. more disposable income) beyond the inherent benefit of keeping dollars circulating in the local economy.

Examples of Implementation

The DOE Weatherization Assistance Program helps states with the development of new weatherization technologies and helps leverage the integration of weatherization with other energy efficiency and housing resources. Larger communities will typically have some level of weatherization assistance available to residents.

Political Feasibility

Weatherization program exists in many communities, and assistance is available through State Weatherization Offices in all fifty states. There is renewed support and potential increase in funding in the wake of the energy challenges highlighted in the western United States.

Summary of Costs and Benefits

Average energy savings could range from 20% to 40% depending upon the extent of improvements made to residences. The DOE Weatherization Assistance Program has documented savings up to 33.5% in homes that had not yet received any electrical base-load reduction improvements.

Depending upon the extent of improvements made to residences, the estimated costs could range from $1800 to $3000 per residence. The maximum allowable average for the DOE Weatherization Assistance Program is $2500 per residence.

Regional Coordination/Interaction with Other Policies

The network for state implementation is already in place, but further coordination with communities would serve to enhance the success of the weatherization efforts in the context of a more comprehensive energy strategy.

Required Action

Implementation of a new program can begin within 6 months of funds availability. Under the DOE Weatherization Assistance Program, a network of various types of organizations delivers weatherization services. These organizations include Community Action Agencies, not-for profit

agencies, local government, and quasi-government agencies, and deliver the services using both professionally trained crews and local private contractors. While the law restricts the DOE Weatherization Assistance Program and its delivery network to providing services to only low-income residents, the network of service providers can be (and in some areas already are) expanded to provide services to non-low-income residents through other local or regional programs.

Energy Efficiency Best Practice
Shading and Landscaping

Description of the Practice

To reduce the consumption of electricity and heating fuel for heating and cooling, homeowners should be encouraged to install landscaping and exterior shading devices. Such activities can be stimulated by: providing low or no cost trees; incentives for tree planting and shade device installation; supporting existing tree planting organizations; and educating residence through energy conservation information efforts.

Shading and landscaping for energy conservation covers a wide variety of techniques which can substantially lower summer cooling costs through reduced solar heat gain and lower winter heating cost by shielding structures from cold winter winds. Landscaping techniques include planting trees, shrub, ground cover and climbing plants. Shading structures include overhangs, stationery awnings and shutters, rolling blinds and awnings, and louvers. For all shading and landscaping features, the key is proper positioning. To reduce heat gain, measures should be installed on the south, west and east sides of the building. To reduce winter heating requirements, planting and shading structures should be installed on the windward side of the home.

For landscaping to be most effective, climate-adapted trees and plants need to be positioned properly and sized to take into account growth. Deciduous trees are preferable because they provide summer shading but allow warming of the home in the winter when the tree has no leaves. Awnings should be of certain length and angle to allow for winter heat gain and summer sun shading. Exterior shade structure should provide for airflow between the structure and the home to avoid becoming a heat trap next to windows. Although shading structures perform well at reducing summer heat gain they only provide shading to a limited area (windows). Trees, of sufficient size and properly placed, can provide the added benefit of shading windows, wall and roofs which can dramatically reduce summer radiation and reduce cooling requirements.

Public Policy Rational

Tree planting programs benefit an entire community by decreasing neighborhood temperatures, reducing air pollution, providing habitat for wildlife, controlling erosion and wind, reducing water consumption (if planting climate-appropriate plants and trees), and beautifying an area. Trees are planted internationally for carbon sequestration and to offset global warming. The benefit of trees and tree planting programs are universally accepted. The planting of trees has tremendous energy and aesthetics benefits, which could be capitalized on if promoted aggressively.

Examples of Implementation

Since 1990, Sacrament Municipal Utility District has provided support to the Sacramento Tree Foundation that has planted more than 300,000 shade trees around residences in the area. Services provided include trees (4'-7' tall), planting and selection advice, tree delivery, and materials necessary to support and fertilize the tree. The customer must participate in tree care education program, sign a pledge to maintain the tree(s) and in return they receive the services above and a visit by a forester to determine proper tree type and placement.

Since 1993, Tucson Electric Power Company has sponsored Trees for Tucson, a partnership with Tucson Clean and Beautiful. This program has provided more than 24,000 trees to local homeowners. Homeowners are eligible for up to two, five-gallon desert-adapted trees. The owner must agree to plant the tree(s) on the west, east or south side of their residence and are

provided planting and maintenance materials. Requests for trees are filled through neighborhood groups and are provided in the spring and fall planting seasons.

Global ReLeaf, a program of American Forest, was launched in 1990 to help reduce global warming and improve the environment. Since its inception 12.5 million trees have been planted worldwide. The goal of the program is to plant 20 million trees. Almost every state and many Indian Nations participate in the Global ReLeaf Program

Political Feasibility

Tree planting efforts are extensive and well established throughout the country. Augmenting existing activities should be viewed positively. A potential issue is if ratepayer money should be used to support tree-planting programs that could benefit one ratepayer over another.

Summary of Costs and Benefits

Energy savings achieved from the addition of shading and landscaping features vary greatly. According to SMUD, trees properly selected, planted and cared for can begin to reduce home cooling costs within three years. They report that f{PRIVATE "TYPE=PICT;ALT=Graphic of red arrow bullet point."}ully grown; properly placed trees can cut home cooling costs by up to 40 percent. The Shade Tree Program Impact Evaluation prepared by SMUD show a weighted average per program participant as follows:

Savings in cooling at tree maturity: 95kWh and .038 kW
Increases in heating at tree maturity: 21 kWh

SMUD found that trees increase heating costs due to partial shading. However their study states that the heating increase of direct shading is offset by the decrease in heating loads due to the effect of trees as a windbreak.

Estimates on the cooling reduction benefits of tree planting from national organizations range from 15 to 35 percent. A realistic and achievable figure is 20 percent. Figures for reduction of heating costs if trees are planted as a windbreak are 20 to 50 percent. An American Refrigeration Institute study concluded that temperatures inside a home could be reduced as much as 3-degree Fahrenheit just by shading just the outside portion of a split air conditioning system. A South Dakota study found that windbreaks to the north, west and east of homes cut winter fuel costs by an average of 40 percent. Tree wind breaks on just the windward side reduced fuel consumption by an average of 25 percent.

Savings achievable from the installation of exterior shading devices are very site specific relating to window size and orientation and type of shading technique use. According to the National Bureau of Standards louvered shutters reduce solar heat gain by 80 percent, awnings by up to 65 percent on south-facing windows and 77 percent on west-facing windows. The Advanced Buildings Organization estimates that shade structures cost approximately $40 per square foot installed.

In addition to reducing cooling and heating costs, trees beautify a home. According to the Department of Realtors, mature trees can increase the value of a home by fifteen percent.

Regional Coordination/Interaction with Other Policies

Tree planting efforts should not conflict with any other policies. In fact, there are reforestation, beautification, and global warming reduction policies in place that support tree planting. If not already included, energy conservation advocate organizations should add shading and landscaping to existing conservation information.

Required Action

Most every locale has an organization dedicated to tree planting. In some cases tree planting organizations receive utility, state or local funding. To increase the number of trees being installed by homeowners existing programs should be strengthened. If funding is not available to provide free or reduced cost trees, homeowner should be education about the tremendous energy and aesthetic benefits of tree planting. State or local energy or environmental agencies, utilities, garden clubs, agricultural extension service or nursery organization could conduct this education.

Energy Efficiency Best Practice
Residential Cooling System Servicing & Repair Program
(Formally Duct Sealing & Cooling Systems Tune-up and Repair)

Description

Numerous U.S. studies have demonstrated that most existing central air conditioners and their air distribution systems (ducts) have installation or operational problems that reduce system operating efficiency, degrade comfort in the home, shorten equipment life and can affect occupant health and safety. Nationally, 20 percent or more of all heated and cooled air produced by a home's heating, ventilation and air conditioning (HVAC) system is lost through leaks in the air distribution systems. Approximately 70 percent of all central air conditioners have inadequate airflow over the coils and/or improper levels of refrigerant. These conditions may be present in existing as well as new homes. The goal of the residential HVAC system servicing and repair program is to identify and repair problems in existing homes. Solutions to identified problems include: increasing levels of refrigerant charge to manufacturers specifications; increasing airflow across coils and repairing leaks in the duct system using long-lasting mastic and other materials. Encouraging service and repair work can be accomplished through utility rebates or by educating HVAC contractors of the benefits of offering service and repair as part of their normal complement of services.

Public Policy Rational

The greatest benefit of a service and repair program would be the immediate benefit to the homeowner who would see a reduction in energy costs for cooling and an increase in comfort. Homeowners would also benefit from reduced maintenance costs and longer equipment life. This program would also reduce overall energy demand and peak electricity usage. This program must be implemented on a house-by-house basis. To have a noticeable effect, many thousands of homes may need to undergo system and duct repair. According to John Tooley of Advanced Energy Corporation, in the state of Florida 10% of the state's generation is wasted on duct leakage alone.

An issue of importance is who will pay for this service. Although highly cost-effective, many homeowners are deterred from performing an audit for a problem they cannot see. Several states in the region are increasing their demand side management (DSM) programs or considering rebuilding a utility DSM program where it had been cut as part of deregulation; this may provide an opportunity to support servicing and repair programs.

Examples of Implementation

San Diego Gas and Electric conducts a rebate program for homeowners who have air conditioning and duct testing and tune-up services performed. An approved contractor must be used to complete the work. SDG&E is working with the Proctor Engineering Group on training of the HVAC industry. Eligible residents can receive a rebate of $75 per unit for air conditioning testing and repair and $50-250 per system for duct testing and repair. However, there are relatively few such programs in the West at this time.

Duke Power Company of North Caroline conducted a duct-sealing program in the early 1990s that identified clients through mass mailings. The power company paid for half of the $100 analysis cost and ninety percent of the repair costs up to $230.

At the present time there is a lack of HVAC technicians who are trained to diagnose problems and provide corrective action. If the demand for services can be increased (through education or rebate programs) existing companies may add these services as a core part of their business. Adding diagnostic and repair services to annual maintenance checks will reduce costs for homeowners and increase sales for HVAC contractors. Other examples of implementation include: adding diagnostic and repair programs to the existing Weatherization Assistance Programs; identifying candidates through utility or builder high utility bill complaint programs; or by specific regions or income classes.

Political Feasibility

There should be no political issues with implementing a residential HVAC system servicing and repair program. This program would result in a direct and immediate saving to homeowners. Additionally, targeting low-income homeowners would be beneficial since this population segment spends a greater percentage of their income on energy than moderate or high-income residents.

The largest barriers to implementing this program is education of the HVAC contractor industry to enable them to provide the service and to homeowners to understand the financial and other benefits of a properly operating HVAC system.

Summary of Costs and Benefits

Service	Potential Energy Savings	Potential Peak Demand Savings
Charge/air flow	17%	7%
Duct sealing/repair	10%	10%
Combination	24%	14%

A study commissioned by Arizona Public Service Company found that peak load could be reduced 1.22 kW for a total cost of $210. Yearly consumption could also decrease by 1,571 kWh. Savings for individual measures are:

- Reducing duct leakage to less than three percent of system airflow, at a cost of $75, will result in a 0.50 kW reduction and a 417 kWh reduction;
- Increasing duct insulation from R-4.2 to R-8, at a cost of $65, will result in a 0.14 kW reduction and a 164 kWh reduction; and,
- Correcting AC charge and airflow rate, at a cost of $70, will result in a 0.77 kW reduction and 1143 kWh reduction.

The cost to provide a service call to properly charge or correct airflow on a system is approximately $100. The cost to conduct a duct leakage diagnostic test is approximately $100-300, depending on the home, system type and the number of trained technicians available in a given area. Corrective action on ducts can vary from $100 to several thousands of dollars if the system requires major renovation. The cost of these services could be reduced by approximately $75 if they are provided at the time of a normal service call. In addition to the energy savings, homeowners would benefit from reduced maintenance costs, longer equipment life and improve comfort and safety.

Regional Coordination/Interaction with Other Policies

For correcting existing home deficiencies, contractors must be educated on diagnostic and repair techniques. This may be most efficiently done on a state-by-state basis. A duct-sealing program can be folded into existing weatherization and other home improvement programs that already

have funding. Additionally, if not already provided, utilities could add a rebate for HVAC servicing and repair.

Required Action

Education of the HVAC community is essential to build the network of competent contractors who could perform the work. In Arizona, Nevada and California, utilities are partnering with training organizations to work with subcontractor associations to train the HVAC trades people. State energy offices, contractor education organizations or utilities can work with the local industry to increase the number of trained technicians. Citizens will need to be encouraged to participate through financial incentives (rebates) and education. If rebates are not currently offered, utilities could be encouraged by advocacy groups or required by the public utility commission to include rebates for this service.

Energy Efficiency Best Practice
Residential Direct Evaporative Cooling Program

Description

Before the advent of air conditioners, homes in the arid southwest were cooled with evaporative coolers. Evaporative coolers are effective in cooling a home in low and moderate humidity conditions, however, in periods of high humidity, these devices may cool inadequately. During the typical southwest summer, humidity is too high for evaporative coolers to provide reasonable comfort for four to ten weeks. Though evaporative coolers cost less to install and substantially less to operate, the technology is viewed as second rate compared to air conditioners. For these reasons new homes have air conditioners installed, but rarely evaporative coolers. Furthermore, when an evaporative cooler fails it is often not replaced and air conditioning is installed.

The goal of this program is to encourage consumers to replace their existing evaporative cooler or install evaporative cooling in new or existing homes. The city of Phoenix reports that 43-46 percent of all single-family homes have evaporative cooling or evaporative cooling and air conditioning systems. Providing incentives to retain and replace evaporative coolers will help maintain this substantial penetration.

There are two types of evaporative coolers widely used -- one-stage coolers and two-stage units. The two-stage or indirect/direct evaporative coolers are just becoming available and offer significant advantages over one-stage coolers. According to product information from Smart Cool, the new two-stage evaporative coolers can match the cooling of a three ton air conditioner, in a well insulated house, while using only 20 percent of the energy -- peak demand for these units is only 400 watts. As they become more readily available, consumers may opt to choose two-stage evaporative units for their cooling needs.

Public Policy Rational

The expanded and continued use of evaporative coolers is beneficial to the public, because the technology greatly reduces summer cooling costs for residents, reduces peak demand for utilities, and does not use ozone-depleting chemicals. On the other hand, evaporative coolers use a substantial amount of water. In areas where summer water supplies are not adequate, promotion of these systems may not be appropriate.

Examples of Implementation

No examples were found on programs to encourage replacing air conditioners with new evaporative coolers in residential buildings.

Political Feasibility

Promotions to retain and replace evaporative coolers should not create any political issues. New home builders should be encouraged to include evaporative coolers in homes instead of installing air conditioners. The home building industry almost exclusively installs air conditioning systems therefore, asking them to only install a less expensive product that is viewed as potentially inferior, would be met with resistance.

Summary of Costs and Benefits

A Tellus Institute study, *An Economic Analysis of Achievable New Demand-Side Management Opportunities in Utah*, estimated that evaporative cooling systems save approximately 1,600 kWh per year over air conditioning and use between one-third and one-fifth of the energy of air conditioning systems. In addition, a study by ETC Group of Utah estimated that evaporative coolers reduce summer peak demand 1.8kW over air conditioners. The Tellus Institute estimated a demand reduction of 1.6kW.

Regional Coordination/Interaction with Other Policies

This program could be added to the incentives utilities currently offer to homeowners in the form of a rebate. If funding were available, adding to a utility's existing rebate program would be the quickest method to encourage replacement of existing air conditioning systems and adding new evaporative coolers.

States that already have or choose to launch a market transformation program for other energy efficient residential products (such as lighting or insulation) could include evaporative coolers. Since evaporative coolers only work in certain climates it may be preferable to market the coolers by geographic region within states (desert regions of New Mexico) to reach the correct audience.

Required Action

Since evaporative cooling equipment costs are relatively low ($350-500) modest rebates could be offered to give homeowners an incentive to replace or add new evaporative coolers. Incentives could be offered through the local utility or through public purpose funding. To ensure homeowners are educated about the benefits of evaporative cooling, the home building industry should be encouraged to offer evaporative cooler systems information as a compliment to air conditioning systems. The public can also be educated through HVAC contractors about the benefits of replacing air conditioning systems or adding evaporative coolers in their homes. When two-stage evaporative coolers are available they can also be promoted as a comparable alternative to air conditioning units. Since evaporative coolers use about one-quarter of the energy of an air conditioning system, cost savings and the short payback period should be stressed to homeowners.

Energy Efficiency Best Practice
New and Replacement Residential Cooling Systems Program

Description

Air conditioning drives residential sector demand for summer-peaking utilities, particularly in warmer regions of the West, and can be responsible for over 20% of utility system peak electricity usage. Several hundred thousand central air conditioning systems are installed or replaced in the West each year. The residential Heating, Ventilation, and Air Conditioning (HVAC) business is currently a low-bid business where investment decisions are driven by the desire to minimize first costs. This results in very few high-efficiency equipment installations. In fact, according to a report by the American Council for An Energy-Efficient Economy (ACEEE) less than 4 percent of all air conditioners sold across the county were Seasonal Energy Efficiency Rating (SEER) 13 or higher, while approximately three-fourths were SEER 10 (the minimum allowed by law). Each unit that is installed at minimum efficiency versus high efficiency (SEER 13 and 14) can add approximately 0.7 to 1.0 kW to peak demand. Significant reductions in demand can be achieved through a well-conceived and targeted program to ensure those central air conditioner replacements and new installations have a SEER 13 or higher.

The New and Replacement Residential Cooling Systems Program's goal is to improve the efficiency of central air conditioner systems. The program targets all residential dwellings where a new or replacement central air conditioner or heat pump is being purchased and installed.

The program also promotes sales of high-efficiency equipment and system improvements, including correct sizing and installation practices that increase operating efficiency and reduce peak demand. The long-term goal is to transform the residential air conditioner/heat pump market to one in which quality installations of high-efficiency equipment is commonplace.

Public Policy Rational

When making purchases, consumers are typically driven by their lack of knowledge of option and their impacts or first costs. Rarely do consumers compare the initial cost and operating cost of an appliance. By educating consumers and contractors about high efficiency and properly sized and installed HVAC systems, citizens will be able to make more informed choices as well as reduce their monthly utility payments. The resulting savings can then be spent in other areas that can have a positive effect on the local economy. For utility companies, this program can reduce peak load.

Examples of Implementation

Three of the large investor-owned utilities in New Jersey (Public Service Electric and Gas, GPU Energy and Conectiv Power Delivery) have a high efficiency HVAC program. Incentives of $300-$400 are offered for SEER 13 and $500-$600 for SEER 14 units. These incentives cost approximately two-thirds of the increment cost of the efficient units. In 1999, 16,000 rebates were distributed -- half for SEER 13 and half for SEER 14 models.

Political Feasibility

This program should not create any political issues, especially if no incentives are offered. If incentives are offered, these will compete with existing incentive programs.

Summary of Costs and Benefits

Increasing equipment efficiency and improving sizing and installation practices affecting actual operating efficiency, are the two major program components designed to produce energy and peak demand savings. Together, they could reduce central air conditioning energy consumption by 35-45% and peak demand by 25-35%. Proper sizing, charge, and airflow would save 10-20% of electricity use and 5-15% of peak demand, depending on whether the installation is in a new or existing home. A 25-35% peak demand reduction would save about 0.7-1.0 kW per home depending on geographic location.

The incremental cost of an average, residential SEER 13 central air conditioner is around $530-$610 and $640-$765 for a SEER 14; initially, there may be an incremental cost tied to the additional time taken by contractors to properly size and install equipment. These costs are offset, however, by electricity savings associated with the energy-efficient equipment. Homeowners also benefit from reduced maintenance costs and longer equipment life. Homeowners living in hot climates with high electric prices will benefit the most, because of a short payback period -- in contrast to someone in a cooler climate with less expensive electricity.

Regional Coordination/Interaction with Other Policies

To educate all parties involved, regional coordination would speed the process and have a greater impact on energy usage. Since air conditioning manufacturers supply HVAC units across the west, they could be encouraged to provide training to their local dealers to educate them on the benefits of selling efficient units. Training could also be developed for contractors and installers and held in various western states. In addition, consumer education material could be coordinated and distributed throughout the region.

This program would dovetail with the HVAC Service and Repair Program where HVAC contractors are trained to repair existing duct systems and HVAC equipment, complementing utility efforts to encourage residential energy efficiency programs.

Required Action

The steps necessary to implement this program are:

- Implement a training program for HVAC technicians on key elements of quality installation.
- Work with HVAC manufacturers to have them train sales personnel on the benefit of energy efficient HVAC units.
- Provide direct marketing to HVAC distributors and contractors to educate them on proper installation and sizing of equipment.
- Establish an HVAC training certification program and provide the program in as many areas as possible.
- Conduct an aggressive consumer marketing/education campaign on key elements and benefits of efficiency.
- If deemed necessary and appropriate, create an incentive for the purchase of energy efficiency equipment. The incentive could be a rebate from the state or local utility, or a tax incentive from the state or federal government.

In the case of new construction, efforts to promote proper installation of high-efficiency equipment should be coupled with efforts to promote improvements in the efficiency of the building's thermal envelope to capture even greater savings. Utilities and others offering such comprehensive new construction programs could offer builders the option of participating in the

HVAC equipment installation program or a more comprehensive program. Finally, financial incentives would encourage builders to choose the comprehensive option.

Energy Efficiency Best Practice
Residential Cooling Load Control Program
(formerly Residential Direct/Active Load Control on Cooling)

Description

Direct or active load control on residential cooling is a Demand-Side Management (DSM) activity, in which the electric utility actively cycles central air conditioners (CACs) off for an interval of time using centrally activated switching. CACs are typically cycled off for 15 minutes each energy hour during peak times when load reductions are required. Substantial load reductions are achieved by aggregating the savings from cycling CACs over a large customer participation base. Similar programs have been conducted for cycling non-cooling appliances such as electric water heaters and swimming pool pumps.

Another method to reduce peak cooling requirements that may be utilized in the future is the installation smart thermostats. These thermostats can be remotely controlled by a utility to adjust CAC temperature set points, providing more sophisticated control and acceptance by homeowners.

Public Policy Rational & Consistency with Deregulated Electricity Market

Direct load control on residential cooling, whether by cycling or temperature control, creates a "win-win" situation in which both the participating and non-participating customers and utilities benefit. Direct load control customers are rewarded through utility bill credits for the inconvenience of interruptions in power to their CACs or for allowing the utility to control temperature settings. Utilities, on the other hand, benefit from load reductions during peak times. These reductions help reduce the need for costly purchases of wholesale power and can reduce or delay the need for construction of costly new generation infrastructure. Such cost avoidance helps the utilities maintain lower rates for customers.

Examples of Implementation

Baltimore Gas & Electric Co. controls 225,000 CACs at $10 per month electric bill credit for 4 summer months (June-September)

ComEd Controls 72,000 CACs at $5 per month for four months for 15 minute cycling options; customers may opt for a 3-hour turnoff option for a $10 monthly credit.

Florida Power & Light Co. controls 600,000 CACs at $6 per month for 15 minute cycling (7summer months) and $9 per month for a 3-hour turnoff option.

Potomac Electric Power Co. controls CACs for 150,000 participants in Maryland. Options include: 1) $9 per month (5 summer months) for 13 minutes off/17 minutes on for up to 6 hours per 8 control-hour weekday, and 2) $22 per month for unlimited interruption during the control period. A $12.50 per year year-round electric water heater control program is also available.

Public Services Electric & Gas Co. (New Jersey) controls over 147,000 CACs at $8 per month for 4 summer months.

Sacramento Municipal Utility District (California) controls approximately 110,000 residential CACs (as well as 8,000 small commercial CACs) at a credit rate of $2.50 per month.

Utilities may begin to provide smart thermostat controls when technology is more widely available.

Political Feasibility

Direct control CACs programs are voluntary and market-based. Participants are rewarded via utility bill credits, for the inconvenience of lost cooling during "off" intervals, and for increased home temperatures. These programs create a "win-win" situation for both the customer and the utility. While there is typically modest participant attrition in load control programs, new enrollment easily offsets these losses. The future use of smart thermostats may increase participation, because temperatures will be controlled in the home instead of an air conditioner being turned off for a certain period of time. The participant satisfaction for turning off CACs is typically very high (above 90%). Use of smart thermostats should provide satisfaction rates that match or exceed current satisfaction rates.

Summary of Costs and Benefits

The benefits of direct/active load control programs are well known and are outlined above.

Direct/active load control program costs typically include the following:

- Initial investments in switching and control equipment and its installation
- Initial marketing and administration
- Ongoing technology maintenance, administration, and marketing

Direct/active load control programs have been found to be cost-effective on a total resource cost (TRC) basis. TRC compares the electric resource savings (i.e., avoided generation, transmission and distribution costs) with the cost of the program (including equipment, operation, marketing and customers' costs). The TRC approach does not include the credits paid by the utility to the program participants, since such credits do not represent any new resource costs (i.e., utility and participant credits offset one another).

Regional Coordination/Interaction with Other Policies

High efficiency CACs are defined as those with seasonal energy efficiency ration (SEER) that is substantially above the federally established minimum SEER 10.0. However, few such units are in place in the current stock of CACs. As the market penetration of high efficiency CACs increases (especially through DSM high efficiency cooling programs), the savings from direct/active load control programs for residential cooling may diminish.

In addition, because evaporative cooling units use as little as one-fifth the amount of electricity used by a typical CAC, the potential for residential cooling prevails over CACs. DSM programs that encourage evaporative cooling over traditional CACs would, likewise, diminish the savings potential of direct/active load controls on residential cooling.

Despite these potential interactions, residential cooling direct/active load control programs represent the best opportunity for residential customers to participate in a DSM program.

Required Action

Possible avenues for implementation include:

- Residential cooling direct/active load control programs could be initiated as part of a Public Service Commission-ordered utility energy efficiency program

- Program could be funded through a systems benefit charge and implemented by a public or not-for-profit energy efficiency agency or organization

- Utilities could work with new homebuilders and provide incentives to install smart thermostats and control technology in new home construction.

Energy Efficiency Best Practice
Residential Heating System Servicing & Repair Program
(Formally Duct Sealing & Cooling Systems Tune-up and Repair)

Description

Numerous U. S. studies have demonstrated that most existing heat pumps and their air distribution systems (ducts) have installation or operational problems that reduce system operating efficiency, degrade comfort in the home, shorten equipment life and can affect occupant health and safety. Nationally, 20 percent or more of all heated air produced by a home's heating, ventilation and air conditioning (HVAC) system is lost through leaks in the air distribution systems. Approximately 70 percent of all heat pumps have inadequate airflow over the coils. These conditions may be present in existing as well as new homes. The goal of the residential heating system servicing and repair program is to identify and repair problems in existing homes. Solutions to identified problems include: increasing airflow across coils and repairing leaks in the duct system using long-lasting mastic and other materials. Encouraging service and repair work can be accomplished through utility rebates or by educating HVAC contractors of the benefits of offering service and repair as part of their normal complement of services.

Public Policy Rational

The greatest benefit of a service and repair program would be the immediate benefit to the homeowner who would see a reduction in energy costs for heating and an increase in comfort. Homeowners would also benefit from reduced maintenance costs and longer equipment life. This program would also reduce overall energy demand and peak electricity usage. This program must be implemented on a house by house basis. To have a noticeable effect, many thousands of homes may need to undergo system and duct repair. According to John Tooley of Advanced Energy Corporation, in the state of Florida 10% of the state's generation is wasted on duct leakage alone.

An issue of importance is who will pay for this service. Although highly cost-effective, many homeowners are deterred from performing an audit for a problem they cannot see. Several states in the region are increasing their demand side management (DSM) programs or considering rebuilding a utility DSM program where it had been cut as part of deregulation; this may provide an opportunity to support this program.

Examples of Implementation

San Diego Gas and Electric conducts a rebate program for homeowners who have duct testing and tune-up services performed. An approved contractor must be used to complete the work. SDG&E is working with the Proctor Engineering Group on training of the HVAC industry. Eligible residents can receive a rebate of $50-250 per system for duct testing and repair. However, there are relatively few such program in the West at this time.

Duke Power Company of North Caroline conducted a duct-sealing program in the early 1990s that identified clients through mass mailings. The power company paid for half of the $100 analysis cost and ninety percent of the repair costs up to $230.

At the present time there is a lack of HVAC technicians who are trained to diagnose problems and provide corrective action. If the demand for services can be increased (through education or rebate programs) existing companies may add these services as a core part of their business. Adding diagnostic and repair services to annual maintenance checks will reduce costs for homeowners and increase sales for HVAC contractors. Other examples of implementation

include: adding diagnostic and repair programs to the existing Weatherization Assistance Programs; identifying candidates through utility or builder high utility bill complaint programs; or by specific regions or income classes.

Political Feasibility

There should be no political issues with implementing a residential HVAC system servicing and repair program. This program would result in a direct and immediate saving to homeowners. Additionally, targeting low-income homeowners would be beneficial since this population segment spends a greater percentage of their income on energy than moderate or high-income residents.

The largest barriers to implementing this program is education of the HVAC contractor industry to enable them to provide the service and to homeowners to understand the financial and other benefits of a properly operating HVAC system.

Summary of Costs and Benefits

Service	Potential Energy Savings	Potential Peak Demand Savings
Charge/air flow	17%	7%
Duct sealing/repair	10%	10%
Combination	24%	14%

A study commissioned by Arizona Public Service Company found that reducing duct leakage to less than 3% of system airflow, at a cost of $75, will result in a kW reduction of 0.50 and kWh reduction of 417.

The cost to provide a service call to properly charge or correct airflow on a system is approximately $100. The cost to conduct a duct leakage diagnostic test is approximately $100-300, depending on the home, system type and the number of trained technicians available in a given area. Corrective action on ducts can vary from $100 to several thousands of dollars if the system requires major renovation. The cost of these services could be reduced by approximately $75 if they are provided at the time of a normal service call. In addition to the energy savings, homeowners would benefit from reduced maintenance costs, longer equipment life and improve comfort and safety.

Regional Coordination/Interaction with Other Policies

For correcting existing home deficiencies, contractors must be educated on diagnostic and repair techniques. This may be most efficiently done on a state-by-state basis. A duct-sealing program can be folded into existing weatherization and other home improvement programs that already have funding. Additionally, if not already provided, utilities could add a rebate for HVAC servicing and repair.

Required Action

Education of the HVAC community is essential to build the network of competent contractors who could perform the work. In Arizona, Nevada and California, utilities are partnering with organizations to work with subcontractor associations to train the HVAC trades people. State energy offices, contractor education organizations or utilities can work with the local industry to increase the number of trained technicians. Citizens will need to be encouraged to participate through financial incentives (rebates) and education. If rebates are not currently offered, utilities could be encouraged by advocacy groups or required by the public utility commission to include rebates for this service.

Energy Efficiency Best Practice
Promotion of Fluorescent Torchieres

Description

Torchiere lamps have become common in residential use because of their styling and inexpensive cost. However the halogen lamps in the torchiere lamp use more energy that fluorescent lamps and can present a fire hazard because the lamp design is inherently unstable. The goal of this program is to incent people to replace their halogen bulbs with the more efficient and safer fluorescent bulbs. The Northwest Energy Efficiency Alliance (Alliance) has established a market transformation strategy to create a viable market for energy efficient fluorescent lighting in residences by accelerating product availability and customer acceptance and use throughout the Northwest. The project includes support for retail-based consumer awareness/education, initiatives to promote new product innovation, local utility marketing, and product quality verification. The goal is to promote residential lighting based on Energy Star® technical lighting specifications, including compact fluorescent lamps (CFLs), indoor and outdoor fixtures and portable floor lamps (torchieres) to encourage product variety and availability, and communicate the benefits of the products to retail residential consumers.

One of the most successful components of the Alliance's program has been the promotion of fluorescent torchieres and their replacement halogen models. The Torchiere Turn-in is a two-part event consisting of the Turn-in event itself and a promotional safety event called the Torchiere Safety Demonstration. Utilities, with other local community partners, host the turn-in where residents can trade in their halogen torchieres and purchase a safe, Energy Star® torchiere that uses compact fluorescent technology. The media event precedes the Turn-in and builds anticipation for the turn-in itself. The program provides a "how to kit" for the utilities and provides support working with retailers and the media.

Public Policy Rational and Consistency with Deregulated Electricity Market

The policy rationale for this program is two-fold. As with other projects promoted by the Alliance, the electric savings achieved by this program are acquired at a cost per kWh that is less than the avoided cost of building or purchasing the resource. In addition, the program leverages off of the significant non-energy benefit of increased consumer safety with the CFL torchiere models. This program works well in both a deregulated and regulated market because it works within market channels. Both retailers and utilities are enthusiastic about the program because while it delivers energy savings, it also allows them to provide a valuable service to their customers.

Examples of Implementation

The Alliance program developed a Turn-in kit that contains the essential tools for a utility to implement a torchiere turn-in event in their service territory. The kit contains stories of other successful turn-in events, suggestions for partnerships with retailers, community groups and adjacent utilities, and advertising and public relations tools. In addition to the tools provided in the kit, the program also provided support in working with local retailers and incentives to help utilities provide consumer coupons towards the purchase of a fluorescent torchiere. The amount of the coupons varied from event to event and depended upon what the utility felt their customers needed as an incentive.

Local utilities and the Alliance cooperated on this program to secure short-term energy savings and strengthen the long-term commitments of market players (torchiere manufacturers, retailers, etc.). By working together the utilities found it easier to secure sufficient qualifying products at

an affordable price. The Alliance benefited because the utilities had sufficient resources and the consumer connections necessary to hold successful turn-in events across the region.

Political Feasibility

The program is politically feasible on several levels. The program results in energy savings that are least cost compared to acquiring these resources. The program has non-energy benefits including CO_2 savings and increased safety. The CO_2 savings help national efforts to reduce CO_2 emissions. The program is estimated to save 137,213 tons of CO_2 through 2010. Thus, the benefits of a program such as this accrue to several different groups working towards different goals.

The challenges of implementing a program such as this and the barriers that need to be addressed require a great deal of cooperation and coordination between local, regional and national efforts. The marketing of Energy Star requires coordination with federal EPA efforts, manufacturers, buyer groups, large retail chains, local retailers, large and small utilities, consumers and government standards efforts. The success of this program is based upon receiving the cooperation and upon leveraging all of these relationships.

Over the long term, electricity savings from projects such as this are expected to be larger and longer lasting than traditional local acquisition efforts because, if successful, the market will continue to offer targeted products and services even after the Alliance's project implementation has ended. This should also result in reduced utility-sponsored costs for the electricity savings over the long run.

Summary of Costs and Benefits for each Practice or Policy

The Alliance goes through a rigorous cost effectiveness test for each of its programs. In the case of lighting, the inputs include program costs (admin, evaluation $, incentives to consumers,) consumer cost and local utility costs. The benefits include electric savings. The table below details the cost effectiveness for this program from three perspectives: total resource, Alliance and consumer. These numbers include torchieres, screw based CFLs and hardwire fixtures. We have not separated cost effectiveness tests for each measure.

{PRIVATE}**Total Resource Perspective**	**Annual Unit Savings (kWh)**	**Levelized Cost (Cents/kWh)**	**CE Index* (Benefit/Cost Ratio)**
Venture + Post-Venture Period	77.5	1.77	**1.2**
Venture Period Only	77.5	2.85	.9
Alliance Perspective	**Annual Unit Savings (kWh)**	**Levelized Cost (Cents/kWh)**	**CE Index* (Benefit/Cost Ratio)**
Venture + Post-Venture Period	77.5	.34	6.1
Venture Period Only	77.5	.91	2.5

*** If CE Index for Total Resource Perspective and Venture + Post-venture Period is greater than 1.0, then project is deemed cost effective.**

Consumer Perspective	Simple Payback in Years	
	@ 5.0	@ 3.0
Scenario	cents/kWh	cents/kWh
Simple Payback (Yrs) Electricity Savings Only	4.847	8.079
Simple Payback (Yrs) Electricity plus Non-electric Benefits	4.847	8.079

Regional Coordination/Interaction with Other Policies

Over three years ago, the Pacific Northwest embraced the idea of consolidating resources and working regionally to bring affordable, energy-efficient products and services to Northwest markets. The result was the inception of the Northwest Energy Efficiency Alliance and the development of programs like the Energy Star Residential Lighting Program. The program works across utility and state boundaries, allowing the region to speak with one voice sending a stronger message to the manufacturers and distributors than if each utility worked on its own. The region-wide message is that Northwest consumers want the efficient versions of products available in stores where they normally shop at a price they can afford.

This approach works within the normal market dynamic so the supply and demand for energy-efficient products will continue after Alliance activities end. The Alliance's approach to achieving electricity savings is called "market transformation".

Market transformation is complementary to more traditional approaches of conservation acquisition – such as local utility programs. Local approaches typically focus on individual customers. Market transformation efforts work up the market chain with manufacturers or wholesalers and distributors. When local efforts and market transformation work together, more players in the market chain understand the importance of efficiency and the region is likely to achieve greater energy savings. Thus, regional coordination is fundamental to the success of the program such as this.

Required Action

To create a program similar to the Alliance an entity would need to conduct market research, determine a baseline; issue an RFP to hire implementation contractors or operate the program with existing staff, evaluates progress towards program goals, and readjusts the program based on changing market conditions. The Alliance program uses a board, which is composed of electric utilities, state government representatives, public interest groups and energy-efficiency industry representatives, to scrutinize the program and provide guidance.

The challenge of implementing a market transformation program such is the enormous amount of cooperation and coordination between different groups. It requires working with manufacturers, buyer groups, large retail chains, local retailers, large and small utilities, consumers and government standards efforts. The Alliance program is particularly focused on cooperating and partnering with retailers throughout the region. Retailers have the potential to truly "transform" the market so that the benefits of the program continue after the Alliance's role ends.

If other states want to create a program like the Alliance they can build a regional partnership or the program could be administered at the state level. Developing and assisting utilities with bulb replacement events could happen by service territory or on a statewide basis.

Energy Efficiency Best Practice
Fluorescent Hard Wired Fixture Program

Description

Residential lighting consists of hard-wired fixtures that are installed at the time of construction or renovation and lamps that have screw-in light bulbs. Hard-wired fixtures include recessed canned lights and indoor and outdoor lighting fixtures. This program is aimed at encouraging new homebuilders and contractors performing renovations to install energy efficient hard-wired fixtures instead of commonly used fixtures that are not energy efficient. Two methods can be used to achieve this end. Financial incentives can be offered to builders or homeowners or market transformation efforts can be undertaken to change current industry practices.

The Northwest Energy Efficiency Alliance's (Alliance) Energy Star® Residential Fixtures Program is a market transformation effort that aims to create a viable market for energy efficient fluorescent lighting in residences by accelerating product availability and customer acceptance and use throughout the Northwest. The program's goal is to promote residential lighting based on the Energy Star technical lighting specifications, to encourage product variety and availability, and communicate the benefits of the products to consumers. Demand for energy efficient, hard-wired fixtures will increase if products are more available and well known to builders, contractors, and homebuyers.

A rebate program for hard-wired fixtures would be similar to rebate programs for efficient compact fluorescent lamps (CFLs) offered by utilities, and state or local jurisdictions.

There are a good variety of energy efficient outdoor lighting products available, however, the same is not true for recessed can fixtures. This Alliance and the Pacific Northwest National Laboratory have funded a proposal that should make energy efficient canned fixtures available in 2001.

Disposal is an issue with fluorescent lamps, because they contain toxic chemicals that can leach into soil and water if deposited in landfills. Thus, proper disposal of these lamps is necessary for environmental protection. As fluorescent lamps are used more commonly in residential applications programs, proper disposal must be made readily available.

Public Policy Rational

Installing energy efficient hard-wired lighting at the time of construction or renovation is more cost efficient than changing fixtures at a later date. Furthermore, installing such fixtures won't add significantly to the cost of new home construction or renovation and will provide substantial savings to the homeowner. Using a market transformation approach, on the other hand, requires the coordination of manufacturers, retailers, consumers, and builders, but would not necessarily require an outlay of funds for rebates. In fact, impacting the market for hard-wired fixtures has the advantage of being more permanent than programs that promote the installation of screw-in bulbs that can be removed.

A market transformation effort will not conflict with deregulation of the electricity industry. If a rebate program is chosen, funds may not be available from utilities in a deregulated environment. In that case, states may need to rely on public purpose funds.

Examples of Implementation

The Alliance's Energy Star Residential Lighting program focused efforts on two hard-wired fixture product applications: recessed cans and outdoor lighting. According to a recent study by the Consortium for Energy Efficiency, these applications present good opportunities for introducing energy-saving, hard-wired products into the marketplace, because of their significant use in home remodeling projects. The study identified the remodeling/home improvement market as the best option for introducing energy-efficient, hard-wired fixtures since the new construction supply channels were found to be highly fragmented.

Political Feasibility

The program results in energy savings that are "least cost" compared to acquiring these resources. The program has non-energy benefits, including CO_2 savings. The CO_2 savings helps national efforts to reduce CO2 emissions. Thus, the benefits of a program such as this accrue to several different groups working towards different goals. In the market transformation approach, the challenge is to implement a program requiring a great amount of cooperation and coordination at the local, regional, and national levels. For example, the marketing of Energy Star requires coordination with federal EPA efforts, manufacturers, buyer groups, large retail chains, local retailers, large and small utilities, consumers, and government standards efforts.

Over the long term, electricity savings from market transformation are expected to be larger and longer lasting than traditional local acquisition efforts because, if successful, the market will continue to offer efficient products and services even after a project's implementation has ended. This should also result in reduced utility-sponsored costs for the electricity savings. If a rebate approach is taken, funding for other energy efficiency programs.

Summary of Costs and Benefits

The Alliance has gone through rigorous cost effectiveness tests for each of its programs. In the case of lighting, the inputs include program costs (admin, evaluation $ and incentives to consumers), consumer costs and local utility costs. The benefits include electric savings. The table below details the cost effectiveness for this program from three perspectives: total resource, Alliance and consumer. These numbers include torchieres, screw based CFLs, and hardwire fixtures. The cost-effective test has been completed for the measures as a group, not individually.

Total Resource Perspective	**Annual Unit Savings (kWh)**	**Levelized Cost (Cents/kWh)**	**CE Index* (Benefit/Cost Ratio)**
Venture + Post-Venture Period	77.5	1.77	1.2
Venture Period Only	77.5	2.85	.9
Alliance Perspective	**Annual Unit Savings (kWh)**	**Levelized Cost (Cents/kWh)**	**CE Index* (Benefit/Cost Ratio)**
Venture + Post-Venture Period	77.5	.34	6.1
Venture Period Only	77.5	.91	2.5

*** If CE Index for Total Resource Perspective and Venture + Post-venture Period is greater than 1.0, then project is deemed cost effective.**

Consumer Perspective	Simple Payback in Years	
Scenario	@ 5.0 cents/kWh	@ 3.0 cents/kWh
Simple Payback (Yrs) Electricity Savings Only	4.847	8.079
Simple Payback (Yrs) Electricity plus Non-electric Benefits	4.847	8.079

An additional benefit of these lamps is that they provide superior lighting quality and color.

Regional Coordination/Interaction with Other Policies

The Pacific Northwest is the best example of regional coordination with development of the Northwest Energy Efficiency Alliance and the ENERGY STAR® Residential Lighting Program. The Alliance works across utility and state boundaries allowing the region to speak with one voice, which sends a stronger message to manufacturers and distributors than if each utility worked on its own. The region-wide message is that Northwest consumers want the efficient versions of products available in stores where they normally shop at a price they can afford.

This approach works within the normal market dynamic so the supply and demand for energy-efficient products will continue after Alliance activities end. The Alliance's market transformation approach to achieving electricity is complementary to more traditional approaches of conservation acquisition – such as local utility programs. Local approaches typically focus on individual customers, whereas market transformation efforts work up the market chain with manufacturers or wholesalers and distributors. When local and market transformation efforts work together, more players in the market chain understand the importance of efficiency and the region is likely to achieve greater energy savings. Regional coordination has been fundamental to the success of the Alliance's programs.

Creating a market transformation or incentive program for hard-wired fixtures will dovetail and be supported by the DOE/EPA Energy Star program. Programs to promote efficient, hard-wired fixtures will be supported or enhanced by local building codes.

Required Action

In its market transformation program, the Alliance developed partnerships with manufacturers, buyer groups, large retail chains, local retailers, large and small utilities, consumers, and government. The Alliance conducted market research, determined a baseline, issued an RFP, hired implementation contractors, evaluated progress towards program goals, and readjusted the program based on changing market conditions. Their program is particularly focused on cooperating and partnering with retailers throughout the region. The Alliance views retailers as key partners, because they will help continue the program after the Alliance's role ends. The Alliance receives leadership and guidance from a board composed of electric utilities, state government representatives, public interest groups, and energy-efficiency industry representatives.

If a state is going to undertake a market transformation program a similar coalition needs to be formed, but it could operate on a less formal basis without funding. The lead entity, whether a state, an energy advocacy organization, or other, would need to develop an implementation plan, goals, and evaluation methodology. Education on the benefits of efficient products in new and retrofit construction would need to be presented to the affected constituencies. The group should also need to work with manufacturers and suppliers to ensure availability of products. Finally, consumers should be encouraged to request the efficient products to increase demand and success of the program.

If a rebates program is undertaken an availability assessment must be completed to ensure an adequate potential supply of energy efficient hard wired fixtures, a funding source identified, and the program must be targeted to new homebuilders, renovation contractors, or both. In the case of a state-run rebate program, an administrating agency must be designated to disperse funds.

Energy Efficiency Best Practice
Alliance's Energy Star® Resource Efficient Clothes Washers

Description

This project promotes the benefits of Energy Star-qualified clothes washers (RECW) - their substantial energy, water, and detergent savings. It is aimed at increasing the market share of Energy Star-qualified washers through aggressive marketing and support for higher federal efficiency standards for clothes washers.

The program started as the WashWise program in 1997 and has evolved considerably over the past three years. Initially, it was a consumer rebate-driven program with refunds of $130 per machine. As it achieved initial success, consumer rebates were first reduced and then eliminated. Since November of 1998, the program has relied on consumer marketing and retailer support to maintain sales of Energy Star clothes washers. Earlier in 2000, the program expanded to include other Energy Star home appliances.

Public Policy Rational

The electric savings targeted by all Alliance programs have been achieved at a cost per kWh that is less than the avoided cost of building or purchasing the resource. In addition to the electric savings, the washing machine project has resulted in substantial non-energy benefits (water, sewage, and detergent).
All of the energy and non-energy benefits of this program are being achieved with a focus on influencing market players and increasing market share of resource efficient washers through normal business channels. This strategic focus on reducing barriers in existing "markets" by partnering with manufacturers and retailers, coupled with an exit strategy where market players eventually promote resource efficient washers to consumers independent of the program, is consistent with a deregulated market. As consumers recognize the benefits of RECWs and the prices comes down, the demand for resource efficient washers will increase independent of whether the energy market is deregulated or not.

Examples of implementation

The program started with consumer rebates and retailer incentives in 1997 through October 1998, to demonstrate that the resource efficient washers would appeal to consumers with some sort of incentive. In addition, the program provided training and some marketing support to retailers so they could promote the benefits of RECW to consumers directly.

Starting in 1999 the program moved away from consumer rebates and the general media and advertising push, to more large-scale promotions designed to increase utility, manufacturer, and retailer involvement. Retailer incentives continue through February 2001.

For example, the program held the successful Energy Star Grimiest Soccer Team Contest (GST) in the fall of 1999 and 2000. The promotion was divided into two activities: a "grimiest soccer team photo contest" where 15,000 youth soccer coaches were invited to submit a photo of their team at their grimiest, and eight high-profile clinics throughout the Northwest with U.S. Women's National Soccer Team hero, Tiffeny Milbrett. The promotion was designed to generate consumer recognition, placing the Energy Star symbol in the minds of future purchasers. The tag line "Get dirty, score big and clean up with Energy Star" prompted kids to get dirty for the contest and score big through soccer and teamwork, while soccer parents got the chance to clean up with great Energy Star qualified clothes washers. By partnering with Tiffeny Milbrett, the

promotion brought a national hero to the Energy Star® name -- driving media exposure and high attendance numbers for the Grimiest Soccer Team contest and clinics.

In the fall of 2000 the program partnered with the shopping giant, Fred Meyer, in the "The Energy Star® Clean Up Sweepstakes" -- a continued effort to increase consumer awareness of the Energy Star® name and Energy Star® qualified clothes washers. This promotion drove the Energy Star® message further by showcasing qualified clothes washers in the high traffic areas of 110 Fred Meyer stores in Oregon, Washington, and Idaho. Over 13 million people saw these in-store displays and one customer from each store won a washer in a sweepstakes.

In addition to the large-scale promotions, the program continued with the following strategies:

- Developed retailer support and relationships via sales training -- WashLine newsletter and Great Escapes Sweepstakes for salespeople.
- In-store promotions of the full line of Energy Star® qualified home appliances (includes washing machines dishwashers, refrigerators, room air conditioners). With point-of-purchase materials (i.e. brochure, display panels, water bottle savings display, stickers).
- Worked with local utilities promoting the products locally through consumer outreach events, customized bill inserts, print ads, and lobby displays.
- Create support for setting national standards at resource efficiency levels comparable to program levels.

Political Feasibility

The program is politically feasible on several levels. The program results in energy savings that are comparable to acquiring electricity off of the grid. The program has substantial non-energy benefits including CO_2, water, sewer, and detergent savings. The CO_2 savings helps national efforts to reduce CO_2 emissions. The program is estimated to save almost 400,000 tons of CO_2 through 2010. The water and sewer savings benefit consumers directly through reduced utility costs and local governments faced with investments in wastewater. For example, the water savings achieved by the program through the end of 1999 has resulted in an avoided cost of building a one million gallon per day capacity wastewater treatment plant in the Northwest. Thus, the benefits of such a program accrue to several different groups working towards different goals.

The challenges of implementing this type of program and the barriers that need to be addressed, require a great deal of cooperation and coordination between local, regional, and national efforts. The marketing of Energy Star requires coordination between manufacturers, buyer groups, large retail chains, local retailers, large and small utilities, consumers, and government standards efforts. The success of this program is based upon receiving the cooperation and coordination of all of these relationships.

Summary of Costs and Benefits

The Alliance goes through a rigorous cost effectiveness test for each of its programs. In the case of washing machines, the inputs include program costs (admin, evaluation $, incentives to consumers,) consumer cost, and local utility costs. The benefits include electric savings, gas savings (from gas water heaters and dryers), water savings, sewage savings, and detergent savings. The tables below detail the numbers for this program from three perspectives: total resource, Alliance, and consumer.

{PRIVATE}**Total Resource Perspective**	**Annual Unit Savings (kWh)**	**Levelized Cost (Cents/kWh)**	**CE Index* (Benefit/Cost Ratio)**
Venture + Post-Venture Period	439.1	-2.09	**2.6**
Venture Period Only	439.1	5.33	.7

Alliance Perspective	**Annual Unit Savings (kWh)**	**Levelized Cost (Cents/kWh)**	**CE Index* (Benefit/Cost Ratio)**
Venture + Post-Venture Period	439.1	.02	25.0
Venture Period Only	439.1	1.81	1.2

*** If CE Index for Total Resource Perspective and Venture + Post-venture Period is greater than 1.0, then project is deemed cost effective.**

Consumer Perspective

Scenario	Simple Payback in Years @ 5.0 cents/kWh	@ 3.0 cents/kWh
Simple Payback (Yrs) Electricity Savings Only	10.464	17.440
Simple Payback (Yrs) Electricity plus Non-electric Benefits	5.182	6.463

Regional Coordination/Interaction with Other Policies

Over three years ago, the Pacific Northwest embraced the idea of consolidating resources and working regionally to bring affordable, energy-efficient products and services to Northwest markets. The result was the inception of the Northwest Energy Efficiency Alliance and the development of programs like the Energy Star® Resource Efficient Washing Machine Program. The program works across utility and state boundaries, allowing the region to speak with one voice by sending a stronger message to the manufacturers and distributors than if each utility worked on its own. The region-wide message is that Northwest consumers want the efficient versions of products available in stores where they normally shop at a price they can afford.

This approach works within the normal market dynamic so the supply and demand for energy-efficient products will continue after Alliance activities end. The Alliance's approach to achieving electricity savings is called "market transformation".

Market transformation is complementary to more traditional approaches of conservation acquisition – such as local utility programs. Local approaches typically focus on individual customers. Market transformation efforts work up the market chain with manufacturers or wholesalers and distributors. When local efforts and market transformation work together, more players in the market chain understand the importance of efficiency and the region is likely to achieve greater energy savings. Thus, regional coordination is fundamental to the success of the program such as this.

Required Action

For each project, the Alliance conducts market research, determines a baseline, issues an RFP and hires implementation contractors, evaluates progress towards programs goals, and readjusts the program based on changing market conditions. Much of this work undergoes the scrutiny of an

active board that is composed of electric utilities, state government representatives, public interest groups, and energy-efficiency industry representatives.

As mentioned, the challenges of implementing a program such as this require a great deal of cooperation and coordination of different groups. It requires working with manufacturers, buyer groups, large retail chains, local retailers, large and small utilities, consumers, and government standards efforts. At this stage the program is particularly focused on cooperating and partnering with retailers throughout the region. Retailers have the potential to truly "transform" the market so that the benefits of the program continue after the Alliance's role ends.

Energy Efficiency Best Practice
Energy Star Branding Effort Program

Description

Energy Star is a voluntary program sponsored by the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Energy (DOE). Its goal is to increase consumer interest in, desire for, and knowledge of energy efficient products. The program started out rating personal computers (1992) and has grown to a multinational program promoting 31 product categories such as office equipment, appliances, home electronics, and heating and cooling equipment. In order for a product to be identified as an Energy Star product, a manufacturer must make a product significantly more efficient than the standard model (usually from 20-50 percent). Thousands of program partners (public and private) assist in publicizing the brand. Recent studies have shown that 30 percent of U.S. consumers have an awareness of the brand, but little understanding as to what it means.

Public Policy Rational

1. Development of a national brand acts as an incentive to manufacturers to make more energy efficient equipment to qualify for branding.

2. Consumers who develop knowledge and trust of brand will buy products and raise demand for more varied products to carry the Energy Star label.

3. Encouraging industry to develop more efficient products will lower emissions and reduce energy dependency.

Examples of Implementation

Currently the Energy Star program has grown to include 31 different product categories, such as heating furnaces and air conditioners, lighting equipment, appliances, and home electronics. An example of a successful implementation of the branding effort is office equipment. Several types of office equipment are eligible for the Energy Star brand, including computers, monitors, copying machines, and printers. An Executive Order requiring all federal agencies to purchase Energy Star computer equipment resulted in all of the major manufacturers participating in the program. Because of the size of the federal markets and the resulting manufacturers participation, it became easy for all consumers to purchase these products and now it is estimated that 95 percent of all monitors sold are Energy Star branded, as well as 80 percent of all computers and 99 percent of all printers. Because many computer companies sell internationally, there has also been an entrée into international branding. Several other countries have signed agreements to use the Energy Star brand on their computer equipment, including the European Union and Australia.

Political Feasibility

The Energy Star program has been effective at building a brand name that is widely recognized. With more political support and expanded programming, new, integrated systems will be developed such as an 'Energy Star Kitchen' where all aspects of a kitchen can be looked at together.

This is a program with strong public/private partnerships and manufacturer interest and participation. Continued political support is needed to continue and increase consumer acceptance. The program is highly feasible because of its strong buy-in with the private sector, its low cost, and high benefits to the consumer through reduced operating costs and energy savings.

Summary of Costs and Benefits

Costs of Energy Star products vary from standard models. There is not necessarily any additional cost to purchasing Energy Star-rated appliances. As an example, Energy Star estimates the savings for clothes washers to be between 50-70 percent a year totaling an annual monetary saving of up to $90. A new refrigerator will save $35-75 per year in energy dollars compared to operating a 10-year-old refrigerator. This savings is balanced against any additional purchasing costs and some utilities now offer rebates for part of the costs of buying Energy Star-branded appliances.

Regional Coordination/Interaction with Other Policies

Regional market transformation collaboratives have been formed as a result of many states' electric utility market restructuring (there are collaborations in the Northeast, Midwest, Pacific Northwest and California). These groups spend millions of dollars annually promoting Energy Star products. The Federal Energy Management Program can assist in promoting Energy Star products and integrating them into the federal purchasing system. Federal appliance standards assist by setting standard test procedures and also by referencing efficiency levels for some Energy Star products. Additionally, building codes can help by specifying Energy Star levels for some building components.

Required Action

Partnerships can be created and strengthened to increase the number of product categories and the amount of consumer awareness of the brand. State incentives can be encouraged to defray any additional costs for the branded products. States may begin by analyzing the penetration of current Energy Star products in the market place. Energy Star information should be included in current literature about energy conservation produced by utilities, state agencies, and advocacy organizations.

Energy Efficiency Best Practice

Early Retirement and Recycling of Working, Inefficient Household Appliances

Description of Practice

New appliances on the market are often significantly more efficient than similar existing appliances in use, and significant reductions in electric loads can be achieved by promoting the early retirement of the older appliance, before the appliance would ordinarily be permanently taken out of service. The owner of the old appliance is offered an incentive to permit the removal of the unit by a qualified vendor. Interested participants arrange for the vendor to remove the unit from the home, which is then transported to a licensed materials recovery facility for dismantling. Hazardous materials are removed and shipped to qualified disposal facilities, the useful materials are recovered, and the remaining metals are recycled.

Low-income residents for whom replacement of the retired appliance would pose financial difficulties and who are often users of the least efficient appliances, can also receive a new efficient replacement unit at low or no cost.

Public Policy Rationale

The majority of new appliance purchases occur while the unit being replaced is still serviceable and, in most instances, the original unit continues in service either as a spare or in the second-hand market. In such cases, the acquisition of the new unit adds to system loads, regardless of how efficient the new unit is. The retirement of old, working, inefficient appliances reduces system loads much more quickly than waiting many years for the units to expire.

Most appliances contain hazardous and environmentally damaging materials such as mercury in switches and thermostats, PCBs in capacitors, halogenated oils in compressors, CFCs, transmission lubricants, etc. The recovery, proper handling, and safe disposal of these materials is required by state and federal laws. Therefore, it is important that the recycling of appliances acquired in early retirement programs be undertaken by a licensed, experienced operator before steel and other useful materials can be recovered.

Examples of Implementation

Prior to restructuring of the electricity industry, such programs were common in many states focused primarily on household refrigerators -- especially "spare" refrigerators, freezers, and air conditioners. In 2000, Southern California Edison was the only major utility to have such a program continuing in operation. In response to the energy crisis in California, the Edison program has been expanded by the Public Utilities Commission to include other utility service territories. Several municipal utilities currently also offer the program.

Former program sponsors have included:

- Wisconsin Electric Power Company
- Wisconsin Public Service Corporation
- Northeast Utilities (Connecticut and Massachusetts)
- United Illuminating (Connecticut)
- B.C. Hydro
- Northern States Power (Minnesota)
- Otter Tail Power (Minnesota)
- Consumers Power (Michigan
- American Electric Power (Ohio)
- Southern Companies (Florida)
- Jersey Central Power and Light

Rochester Gas and Electric (New York)
Consolidated Edison (Westchester, NY)
Southern California Edison Company
Los Angeles Department of Water and Power
Pasadena Water and Power Department
Riverside (CA) Public Utilities
Imperial Irrigation District
California Public Utilities Commission on behalf of customers of San Diego Gas and Electric and seven Bay Area counties in Pacific Gas and Electric service territory

Political Feasibility

- Program is voluntary.
- The financial incentive compensates the owner of the appliance for giving up what is perceived as a useful and, therefore, valuable appliance.
- Program goals are easily understood by the public, politicians, and the media.
- System benefits are perhaps the highest of any program for the residential sector.
- Savings on energy bills by participants are high.
- The program is entirely compatible with retail competition when funding is accomplished through a fee on all users -- sometimes referred to as a "public goods charge" -- and the program is available to all residential consumers.

Summary of Costs and Benefits

Program costs vary by the type of appliance targeted, ancillary functions required of the vendor, size of the service territory, size of the program, the rate at which the program is to be completed, and the length of the commitment to the vendor. The functions provided in a turnkey program are:

- Markets the program (print, radio, television advertising, point-of-purchase displays, bill inserts, etc.) usually in conjunction with a utility if one is involved;
- Provides a multilingual 800 call-in number and internet site to provide information and accept applications for service;
- Schedules pick-up service (confirms customer eligibility, provides written confirmation of appointment, makes day-ahead reminder call);
- Checks appliance functionality, picks up appliances, and delivers to materials handling facility;
- Removes hazardous materials for disposal;
- Recycles useful materials;
- Sends incentive payments ($35-75/unit); and
- Provides tracking and accounting materials to program manager.

Total costs for such a refrigerator program are expected to be $200 - $250 per unit. The incentive payment is a significant fraction of the unit cost, but also plays a role in participation. The participant provides time and effort to empty, clean, and make the unit available for pick up, and also believes the working unit has value because the incentive is viewed as payment for the time required and for giving up a valuable item, response rates are strongly dependent on the incentive level.

With a mix of primary and spare refrigerators, estimated energy savings are approximately 1,500 kwh/yr at a cost of less than 3 cents/kWh saved. The program has a conservative five-year measure life, representing the number of years the old refrigerator or freezer would have been kept in operation without intervention by the program. In addition, substantial capacity benefits

are achievable with estimated associated peak capacity savings of approximately 0.28 kW/unit. Costs and benefits of early retirement of other appliances vary. By comparison, room air conditioner early retirement saves only a fraction of the energy, but provides approximately the same peak capacity reductions.

Interaction with Other Potential Policy Options

Early retirement and recycling of replaced appliances should be an integral component of any program that provides incentives for the purchase of new appliances, such as Energy Star rebate programs. Without the retirement component, new appliance rebate programs arguably increase rather than decrease system loads. Early retirement and recycling should also be a component in low-income, change-out programs in public and private housing.

To lower program costs a multi-year commitment to the vendor is desirable, which allows the vendor to establish a local materials handling facility, reduce shipping costs, and build an efficient and experienced local workforce. However, multi-year commitments are sometimes difficult in public funding budgetary processes.

With the restructuring of the industry and the advent of retail competition in the early 1990s, all the utilities that had appliance early retirement and recycling programs cancelled them, except for Southern California Edison. The conflicts of interest between promoting energy sales and promoting energy conservation are obvious. In today's industry, all publicly funded energy efficiency programs should be administered by entities that have no incentive to promote sales. This program is entirely compatible with emerging industry structures so long as it is administered by an independent entity with no conflicts of interest.

Required Actions for Implementation

Historically, appliance early retirement and recycling programs were initiated and administered by monopoly utilities under Public Service Commission authority. To the extent that states have retained this model, the program could be included.

In the new competitive climate, the governmental or non-profit entity administering public energy conservation funds could include this program. Moreover, should the administrator make funds available through an open competitive process, the appliance early retirement and recycling measure is likely to be offered by vendors and chosen by the administrator on the basis of its high degree of cost-effectiveness.

Energy Efficiency Best Practice
High Efficiency Furnace and Air Conditioning Standards

Description

In the mid-1970s California and several other states began writing their own appliance efficiency standards. Manufacturers supported standards, but wanted them to be the same for every state in the country. The National Appliance and Energy Conservation Act (NAECA) of 1987 (implemented by the U.S. Department of Energy) governs the efficiency of appliances and ensures that individual states will not override the national standards with their own.

The NAECA set Annual Fuel Utilization Efficiency (AFUE) standards at 78 percent efficiency for residential furnaces. Another rating group, the Energy Star program, requires 90 percent efficiency for residential furnaces. New NAECA central air conditioner standards require these appliances to be 20 percent more efficient by 2006.

Public Policy Rational

Heating and cooling costs for buildings represent approximately one third of the energy used in the United States. Standards ensure that every product on the market is of a minimum efficiency. This efficiency improvement is seamless to consumers. Standards can be ratcheted up at future dates allowing manufacturers time to design and build more efficient products. A small improvement in efficiency has a great impact on nationwide energy use, because of the sheer number of units in use.

Political Feasibility

- Some manufacturers are actively fighting against standards while others support such measures.
- Consumers benefit from higher efficiency by a reduction in operating costs.
- Fewer emissions are created.
- Significantly less energy is consumed.
- Because of their far-reaching affect, national standards are one of the most effective methods to improve energy efficiency. Although it could take many years to push standards through Congress, the gains in energy savings, pollution, and the ease it provides for consumers is worth the effort.

Examples of Implementation

In March of 2001 new regulations were adopted requiring central air conditioners to be 20 percent more efficient by the year 2006. Commercial boilers also are required to be more efficient by 2005. The combined energy savings of implementing these changes are projected in the following chart:

	$ Savings/year	Million of kWh/year savings	Billion Cubic ft. of Natural Gas Savings/year
2010	796	8,174	54
2020	1,768	16,794	154

These figures are found in a report by the American Council for an Energy-Efficient Economy (ACEEE), Appliance Standards Awareness Project. The report, "Opportunity Knocks: Capturing Pollution Reductions and Consumer Savings from Updated Appliance Efficiency Standards" is available @ www.standardsasap.org/appupdate.htm

Summary of Costs and Benefits

The costs of a highly energy efficient air conditioner or furnace vary greatly from the size of the unit to the intended use. It is possible to get some savings with no additional costs to the appliance. Some more technical additions, such as extracting the heat value from exhaust gases can cost $500 and more. The benefits also vary widely. For example, a furnace with an AFUE of .97 in a house with a $1,000 heating bill can save $100 a year over the same heating load with a furnace rated at AFUE .88.

Regional Coordination/Interaction with Other Policies

Setting standards for furnaces, air conditioners, and other appliances is done on a nationwide basis. The Energy Star program interacts with the NACEA standards for furnace efficiency, because it is able to rate the highest efficiencies based on a base-line requirement. International and local energy codes can be updated to include furnace, air conditioner, and other appliance efficiency standards. Efficiency standards will not be affected by the restructuring of the electricity industry happening throughout the nation.

Required Action

New standards have recently been adopted. The current legislation will decide if manufacturers will be credited up to $50 per appliance before the implementation date of 2006. Because efficiency standards are so effective, states, energy conservation and efficiency advocacy organizations, and environmental groups, should strongly support the development of new standards and increasing existing ones. When standards are developed comment periods are provided for input. States can make comments supporting standards, inform others about proposed standards, and encourage them to make comments. Congressional representatives should be educated on the benefits of efficiency standards to increase support for their adoption.

Energy Efficiency Best Practice
Residential Building Codes and Standards

Description

Energy building codes and standards can be adopted on the federal or state level to ensure that commercial, industrial, and residential buildings are built to a minimum energy efficiency level. The 1992 Energy Policy Act required that states adopt the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 90.1- 1989 standard for commercial buildings and review their residential code to determine if it meets the 1990 Model Energy Code (MEC) for residential structure. Adoption of these standards by states varies widely across the country. Approximately half of the states have adopted codes that meet or exceed ASHRAE. Some states, such as California, have adopted their own strict codes (Title 24) while other states have adopted an early version of the MEC or ASHRAE and have not updated or enforced the codes since adoption. The most universally accepted code for commercial and residential buildings is the International Energy Conservation Code (IECC). The IECC combined and updated the latest versions of the MEC and ASHREA codes.

Building codes and standards are usually the minimum acceptable building practice. One advantage of building codes is that energy efficient technology is installed in the building process, which is more cost effective than retrofitting. Statewide codes also provide the advantage of leveling the playing field for the construction industry so building requirements are the same across jurisdictional lines. Standardizing codes can make training and enforcement easier for code officials.

Public Policy Rational

Codes are used as a stick to force industry to comply with minimum building practices. Although not usually favored by industry, codes are effective at ensuring that buildings have a prescribed set of efficiency measures such as insulation levels, HVAC equipment efficiency, and window R-value. Legislating building codes nationally and at the state level can take many years. A reason to adopt a building code on a statewide level is to provide uniformity. Consumers benefit from more efficient buildings, because dollars not spent on energy costs can be spent in other areas. This is particularly true for low-income homeowners who spend a greater percentage of their income on energy. Using less energy has a positive impact on the environment and allows people to be less subject to energy price changes.

Examples of Implementation

Code training programs are being implemented under various grants throughout the United States. The Department of Energy (DOE) supports several training and incentive initiatives and monitors their progress.

HERS (Home Energy Rating Systems) have been established under national standards created by DOE in the late 1980s. This market-based approach raises standards through education and promotion, raising the awareness of consumers and providing a credible tool for builders to promote energy efficiency. In the 1990s this concept was expanded to include the environmental benefits of "green building," which became a "systems approach" to building.

Alternatives to mandatory standards are well established in the form of market-based education and promotion programs operated by utilities (i.e. Good Cents), industry (i.e. Engineered for Life, Built Green Colorado), non-profits, and local/state governments (i.e. E-Star Colorado, state HERS).

Political Feasibility

Mandating codes or other requirements on industry is usually not favored. Adopting an energy code at the state or federal level may be resisted by local and state governments who favor home rule; the building industry would rather have incentives to change, not mandates; politicians wish to limit government regulation; and fiscally conservative organizations see energy codes as costly. Supporters of codes may include government entities, environment and energy advocates and product manufacturers who produce energy efficient building materials.

Summary of Costs and Benefits

Energy savings potential ranges from state to state, relative to the current standard in place. In some cases no standard is in place and in others, enforcement of the standard is weak or non-existent. In that context, for states in the Western Grid not currently meeting the Model Energy Code (MEC), energy savings can range from 164 billion to 645 billion BTUs for single-family residences.

First cost to reach MEC will generally range from approximately $500 to $1200, with average savings between $100 and $200 annually. (These figures are from a 1998 study and do not take into account the recent increase in heating oil and natural gas, which further improves the cost/benefit ration.)

Costs to present code training workshops vary depending on the opportunity to leverage other programs and initiatives (Federal, state, local or industry and trades), availability of local sponsors, fees for training, and cost of supplemental materials. A full day workshop with two instructors and supplemental materials could range between $1000 and $1500.

Regional Coordination/Interaction with Other Policies

Until recently there was not a single code that encompassed residential and commercial buildings. The IECC will make it possible for all jurisdictions to adopt the same standard. This type of standardization will make it easy for builders, designers, architects, and businesses to operate in multiple states. Statewide building codes could allow for regional or statewide enforcement.

Required Action

To adopt a statewide code a champion needs to be identified to advocate for the code and build support. An evaluation of current building practices is necessary to ensure that a code will raise standard energy building practices. Hence, a stakeholder group should be formed to identify issues, as well as possible supporters and foes of the issue. The stakeholders will need to identify state-specific information on the benefit of code adoption and identify a legislative sponsor. Resources are available to states from the DOE, the Building Code Assistance Project, and other organizations.

Energy Efficiency Best Practice
Small Commercial Packaged Rooftop HVAC Replacement

Description

Significant reductions in peak demand can be achieved by a well-conceived and targeted campaign to ensure that central air conditioner replacements, as well as new installations, use high-efficiency equipment. Promoting this efficiency measure through a combination of focused sales training for installation contractors and financial incentives can deliver hard savings quickly.

Most HVAC replacements occur as the result of equipment failure, while some take place according to planned replacement schedules. While replacements occur throughout the year, spring and summer are typically the busiest seasons. Consequently, it is best to announce the promotion of the equipment and to involve contractors and distributors prior to the start of the summer cooling season. Recent improvements in manufacturing practices by major manufacturers allow high-efficiency products to be produced quickly and essentially on-demand as the products are promoted in the marketplace. For maximum effectiveness, the measure should be promoted through distributors and contractors, with several months lead-time allowed for ramp-up and planning.

Public Policy Rational

Replacing inefficient roof top HVAC units with high efficiency models, if done in sufficient quantities, can have a measureable impact on reducing a utility's peak load. Businesses will benefit from reduced energy costs by installing more efficient systems. The payback for efficient systems is typically 3 to 5 years making this a cost effective undertaking for businesses.

Examples of Implementation

California utilities have embarked on similar programs, both in the commercial and the residential markets. A number of utilities across the country have operated similar programs, though often not in conjunction with sales training for installation contractors.

GPU of New Jersey offers an incentive of $55 per ton for 12 SEER units, 5.4 tons or under, and $85 per ton for 13 SEER units. For units 5.4 to 11.25 tons, the incentives are $38 per ton for 10.3 EER units and $73 per ton for 10.8 EER units.

Political Feasibility

Improving the energy efficiency of a commercial business operation makes good business sense. In fact, the possibilities for savings is high, because of the vast number of rooftop HVAC unit in operation. Providing training, outreach, and demonstration on the advantages of high efficiency HVAC units should not create any political issues.

Summary of Costs and Benefits

Air conditioning demand drives the peak for summer-peaking utilities, particularly in warmer regions of the West. On the order of one hundred thousand small, commercial, central air conditioning systems (under 10 tons of cooling capacity) are replaced in the West each year. The vast majority of these replacements are made at the minimum efficiency level allowed by regulation (10 SEER and/or 8.7 EER)[1]. More efficient equipment is available in the marketplace with SEER values of 12 to 13 and EER values of 10.3 to 11. Each unit that is installed at the minimum efficiency level creates approximately 1 kW of additional peak demand when compared to the more efficient options.

Each high-efficiency unit that is installed yields between 0.5 and over 1 kW of peak demand saving relative to a standard installation, depending on building type, size of the unit, and climate zone. Assuming a 1 kW savings per unit, each 1,000 units replaced yields 1 MW of load reduction. Energy savings (kWh) are significant as well, depending on the hours of operation for the unit. Average conditions may yield on the order of 600 to 1000 kWh of savings per year compared to units with minimum efficiency. The incremental cost of a high efficiency unit is approximately $100/ton. Therefore, for an average 4-ton rooftop packaged HVAC unit, the incremental cost per unit is on the order of $400.[2] The American Society for an Energy Efficient Economy estimates that the payback for HVAC replacement is 3 to 5 years.

Regional Coordination

This program is consistent with the adoption of a commercial energy code and is supported in the IECC code. The program will be more successful if there are monetary incentives offered for efficient HVAC units. In a deregulated electricity market, funds for incentives may not be available from utilities and may need to come from public purpose funding.

Required Action

To promote the use of this high-efficiency measure to produce energy savings and reduce peak electric demand, the following initiative elements are required:

- Recruitment: Installation contractors and equipment distributors must be recruited to participate in the initiative. The initiative should be structured so that their participation allows them to receive financial incentives for selling and installing high-efficiency HVAC equipment. Additionally, it allows them to receive sales training to improve their ability to sell the equipment in the marketplace.

- Sales Training: Experience has shown that sales training can help increase the penetration of high-efficiency commercial HVAC systems. In particular, contractors should be provided with methods and tools for presenting the savings associated with installing high-efficiency equipment.

  The preferred method for working with contractors is to reach them through equipment distributors.

- Financial Incentives: To achieve increased market penetration quickly, financial incentives should be provided to promote the sale and installation of the high-efficiency equipment.

  The state energy office or other regional energy cooperative could perform these activities. Financial incentives could come from local utilities or from public purpose funds.

---

[1] The electric energy efficiency of air conditioners is measured in terms of Seasonal Energy Efficiency Ratio (SEER) (for units of 5 tons and under) and Energy Efficiency Ratio (EER). Higher SEER and EER values mean higher efficiency.

[2] This incremental cost includes equipment only. In some cases, incremental installation costs may be incurred as well.

Energy Efficiency Best Practice
Commercial Indirect/Direct Evaporative Cooling Program

Description

An emerging technology for cooling of commercial buildings in desert climates is indirect/direct evaporative cooling (IDDEC). This technology can greatly reduce energy usage in a building while matching the cooling capability of traditional cooling systems. These systems cool air in two stages. In the first stage, incoming air passes through a water-filled heat exchanger that cools without adding moisture. In the second stage, air passes through a water-soaked pad where the temperature drops more and the air picks up water, which increases the humidity. Single stage evaporative coolers have not traditionally been used in commercial applications, because they can not provide adequate cooling as humidity increases. The two stage IDDEC units can provide adequate cooling even during high humidity conditions.

Public Policy Rational & Consistency with Deregulated Electricity Market

Use of evaporative cooling can greatly reduce cooling costs for commercial and industrial customers. This program is undertaken on a business by business basis. Thus, each business needs to evaluate if the IDDEC is appropriate for their operation. Since this technology reduces peak load, business may be interested if they have substantial loads and demand charges. Incorporating an IDDEC system into the design phase of a building is most efficient. To encourage the use of this cooling technology designers and architects must be educated. This process is the same in a regulated or de-regulated market.

Examples of Implementation

Victor Valley Water District designed their new facility to be resource efficient. As part of the innovative design, an indirect/direct evaporative cooling system was installed in this single story, 16,700 square foot building. The building is estimated to use one-third of the energy of a comparable building. Although the building contains many energy efficient features, the savings attributed to the indirect/direct evaporative cooling system alone is 34 percent of the total energy cost for the building. The building does have a back up cooling system, but the IDECC has been able to meet 98 percent of the cooling requirements during operational hours. In addition, occupants of the building report that the added moisture in the air makes the building more comfortable in the dry climate.

Political Feasibility

There should be no political issues with the promotion of the IDDEC. This technology is increasingly being used in commercial and industrial facilities in dry climates. The system offers tremendous savings in cooling costs, which is attractive to building operators.

Summary of Costs and Benefits

In a study prepared for the State of Utah the Tellus Institute estimates the following:

Indirect/direct evap cooling	Measure Lifetime (years)	Annual kWh Savings per unit	Summer Peak Savings: kW/unit	Incremental installed Cost ($/unit)
Medium/large size system	24	182,325	140.3	$120,000
Large size system	24	232,050	178.5	$280,000

Regional Coordination/Interaction with Other Policies

The promotion of IDDEC could be dovetailed with other programs aimed at educating architects, designers, and the building community. Since these systems are not yet in widespread use, architects and designers must be educated about the advantages and how they can be added to energy efficient building design. These systems can also be promoted as part of a green building program where points are awarded for inclusion of various energy and resource conserving technologies and products.

Required Action

Although IDDEC systems are commercially available, they are not currently in widespread use. A promotional program may be necessary to increase the knowledge of and use of these systems. This could involve:

- Identification of architects and designer and building construction firms that build commercial and industrial facilities that could use IDDEC.
- Work with organizations like the American Society of Heating, Refrigerating and Air Conditioning Engineers to offer training to mechanical contractors on proper sizing, installation and maintenance of equipment.
- States or local utilities could undertake outreach efforts, including preparing brochures and technical briefs to complement training efforts.
- States or a utility could conduct a demonstration project in the area to show others the technology.
- States or utilities may choose to offer incentives to increase interest and installation of IDDEC systems.

Energy Efficiency Best Practice
Energy Efficient Low-Voltage Distribution Transformers

Description

Most commercial and industrial buildings use electrical power at two or more voltages, and use both three-phase and single-phase power. Distribution transformers are used to convert electricity from higher to lower voltages and from three-phase to single phase. In commercial and light industrial buildings the typical pattern is to purchase 480 V three-phase power from the utility. Motors for elevators and large refrigeration and air conditioning systems use the 480 V three-phase power. Lights, computers, and other electrical equipment use 120 or 208 V single phase power. In heavy industry, electricity is usually purchased at higher voltages. Two or three stages of transformers are used to distribute power within these larger industrial facilities and to supply the kinds of power needed by the devices that use the power.

Distribution transformers are very widely used, long-lived appliances, typically lasting 30 or more years unless they are overloaded for long periods or exposed to excessive voltages. They are relatively efficient as machines go -- 96% and higher. However, because virtually all electricity utilized in commercial and industrial buildings is processed by one, two, or three stages of distribution transformer, distribution transformer losses compound the losses of the devices they serve. An analysis of distribution transformers for DOE (ORNL-6925) estimated that U.S. annual energy losses in distribution transformers is about 0.04 quads. The analysis also estimated the potential for national energy savings resulting from utilization of more efficient transformers at between 2.5 and 10.7 quads over 30 years, depending on what level of efficiency improvement was selected.

Although distribution transformers are made in many sizes and several designs, it is useful to consider them in two groups -- low-voltage and medium-voltage types. Medium voltage distribution transformers are used extensively by electric utilities and larger industrial or commercial facilities. Low-voltage distribution transformers have primary voltages below 1000 V, most commonly 480 V. Low-voltage transformers tend to be significantly less efficient than medium-voltage distribution transformers, because those who purchase or specify low-voltage transformers generally do not pay for the losses from the transformers. Medium-voltage transformers, in contrast, are usually purchased by utilities or industrial entities who pay for both the transformer and the energy lost by the transformer.

Public Policy Rationale

The electric energy savings potential of higher efficiency low-voltage transformers is substantial because most such transformers have relatively low efficiency. The current low efficiency of low-voltage distribution transformers is a result of the fact that those who purchase or specify these transformers have no incentive to choose more efficient units. Generally, commercial buildings are designed built for a customer who will occupy and maintain the building. Consequently, the designer/builder sees only the purchase price of the transformer and none of its operating costs. In addition, low-voltage transformers are generally purchased as a relatively small part of a bid package for all the electrical gear to be installed in a building.

This is a case where the structure of the market does not lead to economically rational decisions and some intervention is warranted.

Examples of Implementation

There are three kinds of activities ongoing at present: voluntary efforts, state building or energy codes, and national energy efficiency standards.

The National Association of Electrical Manufacturers has issued a distribution transformer efficiency standard, TP 1, to encourage selection of more efficient transformers. EPA has used TP 1 as a benchmark for its Energy Star program to encourage purchase of efficient transformers. The Federal Energy Management Program has a program to help Federal buyers identify and purchase energy-efficient distribution transformers. The New York State Energy Research and Development Administration *Energy Smart New Transformers Program* aims to educate electrical system designers, electrical contractors, corporate facility planners, and building developers about Energy Star transformers and their benefits, to offer short-term incentives to build initial demand, and to coordinate promotional activities. There are several utility sponsored programs that encourage utilization of efficient transformers by providing information and/or incentives. Pacific Gas &Electric, San Diego Gas & Electric, and Southern California Edison are cooperating to provide incentives for use of Energy Star dry-type, low-voltage distribution transformers. Sacramento Municipal Utility District is also providing incentives for use of Energy Star dry-type, low-voltage distribution transformers.

Massachusetts, Minnesota, and Wisconsin have adopted building or energy codes requiring new transformers to meet the requirements of TP 1. Additionally, there are ongoing efforts in New York, Vermont, California and Oregon to build the requirements of TP 1 into building or energy codes.

The U.S. DOE has initiated an effort to develop national minimum efficiency standards for distribution transformers.

Political Feasibility

There are no political issues with voluntary programs. However, they do not yet appear to be very effective. Educational efforts do little to overcome the market failure problem. Thus, incentive payments for purchase of efficient transformers may be more effective.

Mandatory programs adopted by several states have apparently overcome political problems, but there have been reports of enforcement problems.

DOE's effort for national standards may very well run into political problems, because there continues to be philosophical opposition from some groups. Manufacturers have generally resisted DOE's regulation of other appliances. The President's budget proposed a 50% reduction in funding for the DOE office developing standards for distribution transformers.

Summary of Costs and Benefits

The 1997 study for DOE (ORNL-6925) examined the cost effectiveness of TP-1 for the 50 states, and found simple pay back periods from 1.7 years to 4.5 for TP-1 efficiency levels. Naturally, the pay back periods were shortest in states with high electricity prices. In most states, efficiency levels substantially higher than TP-1appear to be justified.

Regional Coordination/Interaction with Other Policies

Coordination between state activities and regional efforts is desirable to avoid duplicative incentives and to utilize resources most effectively.

Required Action

The first step is for states to recognize and analyze the potential benefits of more efficient low-voltage distribution transformers. A concerted effort to update energy and building codes to require TP-1 transformers would have a powerful influence on the market. However, because

there has been essentially no demand for efficient low-voltage transformers, they are not stocked by distributors. While most manufactures list Energy Star compliant transformers in their catalogs, some of the largest manufacturers are discouraging their use by charging very large premiums and quoting long delivery times. On the other hand, several smaller manufacturers are quoting reasonable prices and delivery times for Energy Star transformers. Using the technical assistance program developed by the Department of Energy states can create programs geared toward local conditions. If building or energy codes are not utilized, states may need to identify a funding source to provide the incentive to build demand for efficient, low-voltage distribution transformers.

Energy Efficiency Best Practice
Commercial Lighting Program Name

Description

Over the past ten years the energy efficiency of lighting technology has improved dramatically. According to the Department of Energy in 1990 lighting accounted for 39% of all electricity used in U.S. commercial buildings. The American Council for an Energy Efficient Economy (ACEEE), reports that a reduction in energy use of 30 to 50 percent is possible if a building is retrofitted with "first wave" technologies. These technologies include T-8 lamps and electronic ballasts, LED exit lamps, compact fluorescent lamps and metal halide and high-pressure sodium lamps. This equipment is standard for new buildings, but approximately 50 percent of existing buildings have not been upgraded. In addition to upgrading lighting hardware, savings are achieved by installing occupancy sensors, dimmers, timers, photocells, reflectors, and reducing the number of lamps and ballasts. Although highly cost effective, companies may not upgrade lighting technology because of a lack of familiarity with equipment options, staff to complete a replacement or relamping programs, or the capitol cost to purchase new equipment.

This program is aimed at increasing the penetration of high quality energy efficient lighting in the commercial sector – a task accomplished by establishing an infrastructure of lighting professionals trained and equipped to sell and install efficient lighting systems. When business owners and chain stores renovate their stores and offices, they can upgrade to energy efficient lighting technologies. The incremental cost is modest and the return on investment is significant.

Commercial property management companies can offer tenants a superior lighting system during build-out or space renovation that is competitive with the lowest initial cost lighting, when taken on a monthly cash flow basis. Implementing this initiative through local electrical contractors, electrical distributors and lighting suppliers and targeting incentives to these players, ensures sustainability and "buy-in", while providing an exit vehicle once the program's principals are adopted.

Lighting retrofits are one of the most cost-effective energy efficiency measures that can be completed in a commercial facility, providing a one to three year payback. Comprehensive energy retrofits performed through performance contracts can use the short payback period of lighting retrofits to make more attractive longer-term payback projects. If lighting is done on its own, some longer-term projects may not be undertaken.

Public Policy Rational

Energy efficient lighting equipment necessary for installation is readily available for companies considering lighting retrofits. Because lighting retrofits have a payback of one to three years, it is one of the easiest and most cost-effective energy efficiency retrofits that can be performed on buildings. Retrofitting has widespread potential for savings since only half of commercial buildings have efficient lighting. Lighting retrofits will save companies money making them more efficient and profitable, which benefits consumers.

This type of program can operate in a regulated or deregulated market.

Examples of Implementation

Fitchburg Gas and Electric Light Company in Fitchburg, Massachusetts conducted a pilot program with DOE to subsidize the entire cost of a lighting rebate program. Participation for the program (called SUCCESS) climbed from 4 percent to 73 percent when the utility offered full

cost recovery versus just a rebate. Even when paying the entire cost, this program was deemed cost effective for the utility and was incorporated into its demand side management program.

The Green Lights Program, a part of the Energy Star Program, was formed to encourage companies to install energy efficient lighting in an effort to reduce the production of green house gasses. To date, 2000 companies, electric utilities, environmental groups, academic institutions, and state and local governments have joined the partnership.

Pitney Bowes, Inc. of Stamford, Connecticut upgraded 90 percent of their lighting (2.8 million square feet). The annual savings is projected to be $600,000.

Political Feasibility

There is no political down side to promoting lighting retrofits in commercial buildings. If a rebate is offered, a source of funding must be established either through the utility or the state. Desirable companies that complete lighting retrofits can receive recognition by joining the Energy Star program.

Summary of Costs and Benefits

Anticipated savings are calculated from ASHRAE 90.1-1999 baseline for individual facility end users. Energy savings are based on what constitutes a typical small business (3000 square foot) at .7 watts/SF. Assuming a participation sample size of 10 million square feet of small commercial space, 7 megawatts and 113 megawatt hours will be realized over a four-year system operational lifetime. Costs associated with administering and delivering this initiative is less than $.50 per square foot, per project, completed. Avoided electrical costs for this initiative are estimated to be approximately $.027/kWh and $2.25/kW.

Other advantages of lighting upgrades include reduced heat load in a building, because energy efficient lamps and electronic ballasts operate at cooler temperatures, and improved lighting quality for occupants.

Regional Coordination/Interaction with Other Policies

This lighting efficiency initiative can be promoted by a utility in its service territory, by a state through its energy service or business assistance centers, or with DOE and EPA through the Energy Star program. The Energy Star program provides businesses with information to complete proper retrofits and targets lighting as the first step for business to take in improving energy efficiency of their facilities. Finally, because it is widely known, well supported, and has a track record of working with corporations, Energy Star should be used to promote lighting upgrades.

Programs to promote energy efficient lighting can be coupled with more comprehensive energy building retrofits. For example, with a lighting projects have a short payback period, lighting retrofits can be combined with longer payback projects (i.e., HVAC replacement) to make the overall program's payback shorter. Thus, programs that promote performance contracting for energy efficiency upgrades are another natural partner, because lighting upgrades are almost always one of the measures included in an energy performance contract.

Required Action

States need to determine if there is a source of funding to provide rebates to businesses that perform lighting upgrades. In fact, many utilities already offer lighting rebates as a part of their services. If utility rebates are not available, a state can consider creating tax credits or funds for rebates. If rebates or other financial incentives are not available, the program should still be

promoted based on the 30 percent or higher return on investment that can be achieved through lighting retrofits. While the state is working to educate lighting contractors, distributors, and suppliers, states can compile lists of existing knowledgeable lighting contractors, distributors, and suppliers to make available to businesses immediately. Local utilities, state energy offices, or business assistance centers can be used to educate businesses through trade associations or chamber of commerce organizations on the benefits of lighting upgrades. Because businesses may not have or want to send the time on lighting retrofits, they would benefit from assistance in performing assessments, finding financing (if rebates are not available), and performing installations.

Energy Efficiency Best Practice
Commercial Building Service and Maintenance Program
(Formerly Premium Level O & M Service Contract, Continuous Commissioning and Retro-commissioning and Maintenance Programs)

Description

The largest and most quickly implemented savings opportunities in the commercial sector is in operation and maintenance (O & M) savings in existing buildings. Typically a building does not operate at peak performance. To improve building operation, the level of O & M service can be increased. A large percentage of commercial and institutional building space is operated and maintained under service agreements with mechanical contract service firms. These firms have knowledge of energy efficiency, opportunities and capabilities to adjust equipment, temperature settings and setbacks, sensors, check damper positions, clean filters and heat transfer components, tune lighting controls, and adjust economizers and other operational parameters. Attention to these energy details are often not a component of standard service contracts as building owners and property managers have not made them a point of emphasis in their contracts. However, competitive pressures reduce the time allotted to technicians for service calls so, despite the ability to tune the building, those measures are not implemented. This type of "premium" level of service could be easily implemented by expanding existing service contracts.

More sophisticated methods to improve building performance are retro commissioning or continuous commissioning (R & CC) where the entire building's operational system is evaluated and changed to optimize energy and system performance. For R & CC, a building owner may need to hire a contractor who specializes in these activities. Services provided would include:

- establishing a new design intent for the building's performance, based on stakeholders' expectations;
- recording a baseline for the building's current performance;
- systematically verifying, troubleshooting, adjusting, and documenting the performance of the building's system to meet the new design intent;
- comparing the building's adjusted performance to its baseline; and
- checking the building regularly to assure upgraded operation.

If an R & CC program is undertaken, the O & M service contractor or building staff can be trained to maintain the new operational parameters.

Public Policy Rational & Consistency with Deregulated Electricity Market

Premium level service and R & CC of a building makes better use of the existing equipment and has the potential to save a tremendous amount of energy if application is widespread. Building owners and tenants will benefit from a reduction in energy cost and improved comfort in the buildings. Additionally, better maintenance practices can extend equipment life, further reducing costs. Efforts to promote premium level service and continuous commissioning would operate the same in a deregulated or regulated electricity market.

Examples of Implementation

A Commonwealth Edison pilot project retro commissioned 11 large commercial buildings in Chicago. Peak demand was reduced by 2MW. Annual savings were more than 6 million kWh and almost a half million dollars. The average cost to the utility was $132 per kW saved.

Texas A & M University worked with many types of buildings to perform audits and determine the savings for continuous commissioning, which they pioneered. The buildings audited and commissioned included public schools and universities, offices, laboratories, and hospitals.

?? The M. D. Anderson Cancer Center under went a continuous commissioning process. Standard commissioning procedures were completed on the center in 1992 and 1993, producing savings of $145,000 and $62,500, respectively. In 1994, Texas A & M Continuous Commissioning team applied CC techniques and obtained an additional $195,000 per year savings from the same systems previously commissioned to design specifications.

?? The Texas Capitol Extension Building was an efficient building built in 1992 and commissioned to design specifications by the contractor. The before CC process was applied, resulting in a cost index of $1.50 per square foot of conditioned space, and a total energy bill of about $539,000 per year. In 1995, Continuous Commissioning was done saving $144,700 per year or about 27 percent.

Political Feasibility

There should be no political issues with this program. A decrease in electricity usage and associated environmental impacts would reduce costs for building owners and occupants. The program could be implemented by existing service firms using existing contracts.

Summary of Costs and Benefits

Instituting a premium level service program is estimated to save between 5 to 15 percent of a total building's energy use. This approach would be less imposing to many building owners and property managers and, therefore, provide the opportunity for greater participation than a full scale R & CC effort. The cost of the "premium" service could be established on a facility square foot basis and would add some additional increment of service technician time in the facility to check and implement these energy savings inspections and modifications. A utility paid incentive for this premium service would likely result in some of the most cost-effective energy savings available in the market.

Texas A&M University's Energy Systems Laboratory (ESL) pioneered continuous commissioning and has completed dozens of projects. ESL has charted the typical savings and costs as follows:

Building Type	Savings ($/ksqft/yr)	Cost (hr/ksqft)
Hospital	$430	4.74
Lab & Office	$1,260	3.68
Class & Office	$430	2.26
Office	$220	3.29
School	$170	3.36
Average	$540	3.59

R & CC projects have the advantage of providing savings of 5 to 25 percent on energy costs with little to no capital investment. The payback period is 1 to 5 years.

According to the American Council for an Energy Efficient Economy, a 1997 study on 44 retro commissioning projects indicates that the costs ranged from $0.03 to 0.43 per square foot with a median cost of $0.17. The ACEEE estimates that commissioning on average should cost approximately $0.20 per square foot.

Regional Coordination/Interaction with Other Policies

There are several large mechanical contract service firms that operate in multiple states. Efforts launched in one state may provide a benefit to other states. If not already provided, R & CC could be included in the services utilities offer to their customers. Utilities could assist with identifying potential candidates for R & CC and recommend service firms. State energy organizations can make information available statewide on the benefits of this service, along with lists of properly trained service firms.

Required Action

The best candidates for continuous commissioning projects are those facilities that have a motivated owner/O & M team, coupled with those that have a modern energy management system (EMS). Because more control strategies are available through the EMC, more savings are possible. Saving will continue if the owner/O & M groups remain diligent.

A key implementation piece for this approach is working directly with mechanical contract service firms to sell up premium service and R & CC to their existing customer base. To expand the number of qualified service firms and keep cost competitive, a state could establish a training program on providing premium and R & CC services.

To create a demand for services, information must also be provided to building owners and facility managers to familiarize these decision-makers with the opportunities and benefits of premium service and R & CC, and how to obtain quality services. Local building owner and maintenance associations would provide the correct forum for this educational effort.

Energy Efficiency Best Practice
Commercial Load Controls Program

Description

Large commercial and institutional buildings can reduce electricity demand and demand charges by changing and reducing the peak load of their operations. Load reduction strategies range from simple, manual routines, such as switching off high-load machinery during peak hours, to sophisticated energy management control systems (EMCS). EMCS are computerized devices that control heating, ventilation, and air conditioning equipment. EMCSs can provide energy-efficient climate control and can be programmed to reduce electric demand during peak periods.

EMCS reduce peak load by rescheduling and shifting electrical loads, which results in lower peak demand charges. According to CADDET, demand charges can represent about one-third of annual electricity costs for the larger commercial buildings and may even exceed 50%. Demand charges are typically based on only a few hours in the year when electrical loads are at their maximum, in which case, their effect may be spread over a much longer billing period.

All types of buildings can use load controls. However, load management is typically in use now in buildings that have demand meters. Buildings that have high electric load peaks would benefit most, because these loads may be able to be rescheduled or shed.

In some cases there are EMCS systems in buildings, but they have been disabled or misprogrammed resulting in higher than necessary peak energy use. These systems can be reprogrammed to limit peak energy use.

Public Policy Rational & Consistency with Deregulated Electricity Market

Demand charges can be a significant part of a commercial facility's energy costs. Evaluating options and installing controls will reduce peak demand and the associated charges. However, this must be done individually by each business or industry, because the types of load and the opportunity to reschedule or shift that load will be particular to each facility. In the end, reducing costs for energy can make the facility more efficient and competitive.

Adoption of load shifting policies should be consistent with the move to a deregulated market, because peak power costs utilities to most to acquire or produce. This project could be especially beneficial in areas with low reserve margins or transmission constraints.

Examples of Implementation

In an evaluation of fifteen case studies from five countries conducted by CADDET, demand shifts showed 5% to 29% of pre-retrofit annual peak demands, or from 0.4 kW to 1,906 kW. When related to building areas, peak shifts ranged from 3 W/m^2 to 54 W/m^2. Peak demand savings on refrigeration systems for three supermarket stores ranged from 20% to 24%.

Political Feasibility

There should not be any political issues with the promotion of load controls for the commercial sector. Furthermore, if done correctly, there should not be a negative impact on the business or industry. If substantial peak load reduction is accomplished this may reduce or delay the need for additional power plans, which is politically palatable.

Summary of Costs and Benefits

Reduction in peak energy use during high vulnerability hours represent some of the largest dollar savings in avoided cost for serving utilities, and provide extra increments of overall system reliability for the grid. A $/kW "bounty" could be established that would provide incentives for contractors to investigate these opportunities with their existing customer base.

Regional Coordination/Interaction with Other Policies

The program needs to be implemented on a customer by customer basis. Although a little different than a straight conservation program, reducing peak load would complement conservation programs aimed at the commercial sector. It could also be a lead in encouraging industry to implement energy efficiency and conservation, because reducing demand charges will provide immediate savings to the industry. States could work through the existing network of contractors who currently provide services to industrial customers.

Required Action

In most cases, control contractors have existing service contracts in place that allow them to select ready candidates for this effort. Sufficiently incented, these contractors could analyze and implement new control logic in buildings and provide demonstrated peak reductions. The value of these reductions to the serving utility is directly related to electricity commodity market prices during daily peak demand hours.

Energy Efficiency Best Practice
Commercial Energy Codes and Training Program

Description

This program provides training to support the implementation of commercial energy performance standards, reducing energy consumption, and improving overall compliance with current and proposed standards. The most current codes (i.e. International Energy Conservation Code, 2000 version) are encouraged in states and jurisdictions where no code exists, where outdated codes are in place, and/or compliance is weak or nonexistent. Code adoption is supported with technical support including computer software to simplify compliance.
Integral to this approach is the coordination with existing market-based incentive programs such as Energy Star and the US Green Building Council's Leadership in Energy and Environmental Design (LEED) Program. In jurisdictions where codes are not likely to be adopted in the near future, these programs can serve as alternatives to raise the standards through market promotion and education and are also vehicles for training using the code software developed by DOE (i.e. COMcheck-EZ™).

Public Policy Rationale

Current energy prices and availability have heightened public awareness and interest. Long term commercial energy codes and performance standards can improve the commercial building stock. More efficient building stock will reduce owner/occupant cost of operation, reduce emissions, and can improve health and safety of occupants. The environmental impact of electrical generation has driven new energy efficiency initiatives, particularly in large metropolitan areas seeking to reduce air pollution.

Examples of Implementation

Out of the sixteen western states represented by the Western Governors' Association (WGA), eight have adopted the ASHRAE 90.1 (1989) as a state standard for commercial buildings. Of those eight, three states allow voluntary adoption by local jurisdictions. Another four states require ASHRAE 90.1 for state-owned buildings only. The remaining three states have a weaker commercial energy code or no code at all.

Several training opportunities exist under both government and industry programs. Many are being supported and monitored by the DOE under current grant contracts. A coordinated training effort could incorporate these varied programs to some degree. Leadership in Energy and Environmental Design (LEED) is an industry initiative operated through the US Green Building Council. This program certifies commercial "green" buildings under a comprehensive checklist of building options, many of which are energy related.

EPA's Energy Star Building Program also "self-certifies" commercial buildings for the purpose of promoting the building as an Energy Star Building. Energy Star and LEED are the only national programs that offer a voluntary alternative to mandatory standards. LEED focuses not only on the energy systems in the building, but also on the water and the material components related to indoor air quality and worker productivity.

Political Feasibility

Given the heightened awareness of energy issues and the momentum that has been created by the move of several states to adopt the International Building Codes, the feasibility of adopting updated commercial energy codes is relatively high. Substantial support exists for training industry professionals and building officials through Department of Energy programs such as the

Pacific Northwest National Laboratory codes training activities, the State Energy Program (SEP) projects, and free compliance software available via the Internet.

Summary of Costs and Benefits

Energy savings potential is relative to the current standard in place. In some cases no standard is in place and in others enforcement of the standard is weak or non-existent. Many jurisdictions have established ASHRAE 90.1 (1989 version) as a state standard for all buildings, while others have adopted this standard for state-controlled facilities.

Establishing an energy code will require, in some cases, the addition of staff to adequately enforce the code. Existing staff can be trained to verify energy components, but the preferable scenario is to add staff focused on energy systems, to avoid overburdening staff and risk a less comprehensive inspection. The cost of code training will vary depending on the training organization. Opportunities exist for training through State and Federal energy programs, as well as private consulting firms.

Costs to have buildings certified through LEED are typically paid by the building owner.

Regional Coordination/Interaction with Other Policies

Adoption of Commercial Energy Codes has been approached both as a local/regional effort and as a statewide initiative. In the case of regional implementation, the Texas experience is a good example of a diverse coalition that reached consensus around energy standards. The North Central Texas Council of Governments took the lead in setting consistent building standards for 160 municipalities. Energy codes can be a complementary element of a state implementation plan for emissions reduction, or an integral part of a growth management plan. More commonly, state legislatures adopt a code to govern construction of commercial buildings.

Energy codes can provide an umbrella for other energy efficiency promotional programs like tax incentives, rebates, and Energy Star. Energy Codes and training programs will not conflict with the move to a deregulated electricity market.

Required Action

In states where a state commercial energy code exists, the code should be updated to meet the current International Energy Conservation Code standards. Where no state code is currently in place, a plan of action should include a reasonable timeline for adoption of minimum energy standards for commercial buildings. The voluntary programs noted above (Energy Star and LEED) should be considered as part of an implementation strategy. States will need to build a coalition of supporters of energy codes to educate elected officials and encourage them to pass a commercial energy code.

Training programs exist that can be implemented immediately through state energy offices, in coordination with the appropriate building sector representatives like local governments, trade associations, and professional organizations. This should be coordinated by a single point of contact to make the most efficient use of education resources and to serve the greatest number of industry representatives.

An element of the training should include some analysis of compliance with current standards. The assumption that these standards are being met to the letter, or those buildings are performing as intended through the mandated codes, is unrealistic. Building commissioning should be an integral component to a commercial code initiative whether through third party or government services.

Energy Efficiency Best Practice
Combined Heat & Power (CHP) Commercial Program

Description

The Combined Heat and Power (CHP) program encourages new and existing commercial facilities to install equipment to meet their electrical and thermal loads. A CHP unit uses the waste heat produced by an electricity generation system to produce steam or hot water that can be used for space heating, process or domestic hot water, or space cooling. CHP systems include natural gas powered electric generators (e.g. micro-turbines, fuel cells, combustion turbines and internal combustion engines), heat recovery heat exchangers, and absorption chillers. CHP systems are most effective if the commercial facility has simultaneous requirements for heat and electricity. Commercial buildings that are well suited to CHP systems include hospitals, schools, hotels and prisons.

Public Policy Rational

Capturing and using the thermal energy produced as a by-product from fuel sources such as oil, coal, or natural gas increases the power gained from the original fuel source. Conventional electricity generation converts between a third and a half of the fuel's energy into usable energy. There is a tremendous efficiency opportunity to combine electricity generation with the need for thermal loads in buildings and other commercial facilities - converting as much as 85 percent of the fuel into usable energy. CHP technologies reduce energy consumption, decreasing energy bills as well as pollution. These technologies should be supported based on the fact that they make more efficient use of our natural resources.

Another appealing benefit of installing new CHP systems is they employ distributed generation power sources and reduce demands on the existing electricity grid and peak load.

Examples of Impleme ntation

The Navy Medical Center in San Diego currently uses a CHP system with heat recovery to simultaneously produce electricity and medium pressure steam for heating, laundry, cooking, sterilization, and cooling. The 800 kW gas turbine generates 5.7 million kWh of electricity, sufficient steam for 4.7 million ton-hours of chilled water for air conditioning, and 31 million pounds of steam for non-cooling loads. Overall, approximately 77% of the energy content of the fuel is applied to building loads. A proposed upgrade to this system would more than double its overall capacity removing loads from the electrical grid, reducing peak demand, and saving both energy and money.

The Department of Energy has created a CHP Initiative to raise awareness of the energy, economic and environmental benefits of CHP and to highlight barriers that limit its increased implementation. The Initiative supports a range of activities including regional workshops, industry dialogues and development of educational materials. On December 1, 1998, the *CHP Challenge* was issued to double the capacity of electricity generated with CHP in the U.S. by 2010.

In 2000, California Assembly bill 970 was passed which provided $50 million to the California Energy Commission for grants to reduce electricity peak load. CHP projects were eligible for funding.

Political Feasibility

Obstacles face CHP systems that are both technical and political in nature. These include addressing safety issues raised by electric utilities concerning interconnecting with the existing grid, exit fees for abandoned capacity when commercial sites go off the grid, rates for standby power needed during scheduled and unscheduled maintenance of on-site generators, and air quality permit requirements, among others. However, many successful installations show that building owners and contractors can work with utilities, public service commissions, and permitting boards to overcome these obstacles.

Up front costs and operation of more complicated physical plants deter many facility managers from proposing and installing CHP systems. While some companies fully fund projects in-house, other installations result from partnerships between private companies, government installations, energy service companies (ESCOs), and utilities, with each participant sharing in the savings. State and federal governments provide valuable assistance with preliminary proposals and developing partnerships to fund projects.

Summary of Costs and Benefits

Significant up front costs are incurred for installation of CHP systems including proposal, detailed design, purchase, installation, and commissioning of equipment. Electric generators range in cost from $500 to $1000 per kW of capacity depending on size and type; absorption chillers range from $200 to $600 per ton depending on size and efficiency. Costs for design and installation depend very heavily on site-specific conditions and can represent a large fraction of the overall project cost. Cost benefits lead to six to eight year paybacks. Emissions of carbon dioxide, NOx, and SO_2 are reduced 25% to 50% or more.

Regional Coordination/Interaction with Other Policies

The DOE CHP program provides the framework for local education and technical assistance initiatives. States can utilize this DOE program to develop or expand local education and technical assistance programs. CHP is also supported in distributed generation efforts throughout the region.

Required Action

The first step is for states to recognize and analyze the potential conservation benefits of CHP. A concerted effort focused on industry must be undertaken to identify sites for implementation. Using the technical assistance program develop by the Department of Energy, states can create similar programs geared toward local industry. States may need to identify a funding source to provide the incentive to interest industry in CHP installation. States should also review utility and public utility commission policies on distributed generation to determine if there are impediments to the development of these types of systems.

Energy Efficiency Best Practice
Energy Efficient Motor Replacement Program
(Formally Motors & Financial Incentives to Acceleration Adoption of Energy Efficient Industrial Motors and Drive Systems)

Description

Motors and drive systems are used in every kind of industry and in many industrial applications. In 1994, electric motor-driven systems, used in industrial processes, consumed 679 billion kWh – 23% of all the electricity sold in the U.S. There are several types of efficiency improvements, motor efficiency upgrades (installation of new efficient motors), improvement of winding of failed motors (reconditioning motors) and system efficiency upgrades (increasing efficiency of machine or group of machines operating together). Efficiency measures can include: installing Energy Policy Act of 1992 (EPAct)-compliant replacement motors; reducing load on motors through process or design changes; improving the match up of component size and loads; installing variable speed controls on motor drives; installing improved pump, fans and blowers; and conducting better maintenance.

System efficiency measures often require a significant amount of effort on the part of industrial end-users and their vendors to identify, design, implement and maintain. At the present time, only one-sixth of motors installed are premium efficiency motors. Premium efficiency motors have a large additional cost that creates a long payback period. Technical assistance and general education programs are necessary to encourage facility management personnel to use life cycle cost analysis to recognize the long term savings over the additional up front costs.

Public Policy Rational

Encouraging the installation and maintenance of energy-efficient motors will have a large and immediate impact because they use almost a quarter of the electricity produced in this country.

Since motors are such an integral part of any industrial or commercial operation improving their efficiency and performance will improve the overall efficiency and performance of the facility. After the initial payback period a company would realize savings for the life of the motor or system. This will result in lower operating costs for the company and theoretically lower the prices for goods produced.

Examples of Implementation

The U.S. Department of Energy's Motor Challenge is an industry/government partnership that helps industry achieve savings through increased efficiency of motor systems. The Motor Challenge provides technical assistance to industry to identify process improvements. The Motor Challenge has developed motor selection software to coordinate available equipment, operation requirements and economic analysis to allow selection of the most cost-effective and energy efficient motor for specific needs. The DOE has conducted extensive research on motor system operation and specifically identified areas of greatest potential savings per industry cluster.

The Consortium for Energy Efficiency (CEE) has created motor efficiency standards, called the Premium-Efficiency Motors Initiative, that are higher than the established EPAct standards by approximately 1 to 2%. Utilities in several states have adopted the initiative as a basis for motor efficiency programs. CEE is proposing that Premium-Efficiency Motors be branded with the Energy Star label.

The Northwest Energy Efficiency Alliance has teamed up with the Electric League of the Pacific Northwest on a two-year motor management project. One of the Alliance's goals is to increase the

overall efficiency of in-service electric motors in the region by helping to establish effective practices among companies which have substantial motor loads. The benefits for companies are lower operating costs, greater reliability and reduced production downtime.

Several utilities have established programs encouraging the purchase and installation of premium efficiency motors (PEMs). These include:

- Southern California Edison rebates for agricultural customers that purchase PEMs and direct incentives to motor dealers, distributors, and OEMs for stocking, promoting, and selling qualifying energy-efficient motors (up to 50 horsepower) to SCE customers.

- Sacramento Municipal Utility District offers performance based incentives and financing for qualifying industrial motor retrofits.

- Eugene Water and Electric Board provides general rebates on purchase and installation of PEMs.

The most successful programs are increasing the market penetration of premium efficiency motors, increasing the adoption of measures to improve the performance of motor-driven systems and utilizing financial incentives, in addition to the educational outreach described above. However, the resources behind these current motor drive programs are currently limited, and there are not substantial state-level motor drive programs at all in the interior West.

Political Feasibility

The 1992 passage of EPAct and implementation in 1999 demonstrates the historic political feasibility and support for motor efficiency programs at a national level. However, the projected time frame for substitution of standard motors with those meeting the EPAct standard is estimate to be 15 to 20 years at current rates of replacement and retrofitting. To speed replacement and retrofitting, additional incentives and technical assistance programs should be pursued.

Summary of Costs and Benefits

The United States Industrial Motor System Market Opportunities Assessment by the Department of Energy estimates that nationally industrial motor energy use could be reduced by 11 to 18% if facilities managers undertook all cost-effective application of mature proven efficiency technologies and practices. Motor efficiency upgrade can achieve potential savings of nearly 20 billion kWh/year, while system efficiency improvements could save 37 to 79 billion kWh/year. Savings would be $3.6 to $5.8 billion in 1997 dollars at a cost of $11 to 17 billion, roughly representing a 3-year payback period.

Regional Coordination/Interaction with Other Policies

New efficiency programs for motors would support and correlate with the 1992 Energy Policy Act, which applies to most industrial motors and stipulates that all covered products must meet, specified nominal efficiency levels. EPAct requires manufacturers of qualifying general-purpose motors to meet those standards for motors produced after October 24, 1999.

Promoting efficient motors would also fit with the Environmental Protection Agency's Pollution Prevention Program. The P2 program works with industry to identify system and equipment changes in a manufacturing process to reduce pollution.

Required Action

To increase the replacement and retrofit rate of EPAct-compliant energy efficient motors (estimated to be 15 to 20 years) new incentives and technical assistance programs must be created and existing programs expanded. To facilitate this goal, a regional or state collaborative could be initiated to conduct a realistic market opportunity assessment, inventory existing promotional and educational materials and develop updated advocacy program. This collaborative could be built based on the Motor Master Plus program, CEE or NWEEA. Development of training and certification programs for facility managers and industrial engineers will be necessary. These programs should be industry specific - targeting the sectors with the highest levels of potential energy savings: chemicals, primary metals, paper products, water supply and wastewater and mining.

At the same time financial incentives could be developed on a state-by-state basis through utility or government funded rebates. Local efforts could focus on industry clusters located in that state.

Energy Efficiency Best Practice
Industrial Cooling Tower System Optimization

Description

Most industrial sectors use cooling towers to reject heat from processes and refrigeration systems. The cooling towers use one or more fans to force air into contact with falling water. The evaporation of some of the water extracts the latent heat of evaporation from the rest of the water, resulting in a drop in temperature. Cooling tower fan motors are typically single speed or sometimes two-speed systems, which resulted in excessive energy consumption. These fans are either turned on or off in response to the temperature of the water in the cooling tower sump (the cooling water that is returned to the process to be cooled). An integral number of fans are always in operation, often unnecessarily. The use of automatic control systems and variable speed drives for cooling towers can result in increased energy efficiency and reduced operating costs because it reduces cooling tower power requirements. The use of variable speed drive systems allow the speed of the fan, and therefore the amount of air moved, to be continuously variable in response to the exact amount of cooling effect required. Since fan motor power requirements are exponentially proportional to the volume of air moved, significant energy savings can be achieved over simple on-off control of multiple fans. Since the on-off sequencing is done manually instead of using automatic controls, the energy saving impact of variable speed drives would be even greater.

Public Policy Rational & Consistency with Deregulated Electricity Market

Cooling tower system optimization will reduce the cost of operation for the plant that can make the industry more efficient. Potential savings in producing industrial products can be passed on to consumers. Optimizing equipment may allow the industrial customer of operate more competitively. The installation of variable speed drives and control systems will reduce the number of hours a motor(s) will operate which will have a direct effect on energy consumption and the resulting environmental emissions. States can work to promote cooling tower system optimization in a regulated or deregulated electricity market. If public purpose funding is available incentives may create more interest in and activity for industry to improve efficiency.

Examples of Implementation

A number of motor system optimization programs have been and are in place by government and utilities. The US DOE Best Practices program (formerly Motor Challenge) has and continues to develop case studies of motor system optimization for pumps and fans at industrial sites across the country. Regional programs such the Northwest Energy Efficiency Alliance's Drivepower Program is also implementing motor system optimization activities. Specific optimization strategies (e.g. use of variable speed drives for variable loads) are often supported by utilities through financial incentive programs for purchase of VFDs.

Political Feasibility

There should not be any political issues with this program to promote system optimization in industry. However this market segment has always been difficult to reach. A concerted effort by government and utilities is needed to encourage industry to identify and act on efficiency measures.

Summary of Costs and Benefits

According to the California Energy Commission, variable speed drives can cost about $3,000 for a 5 horsepower motor to about $45,000 for a custom built 300 horsepower motor. Larger variable speed drives can cost more. The playback period for these drives is a few months to less than

three years for 25 to 250 horsepower models. There is also savings in reduced maintenance and longer lasting equipment.

According to the Michigan Consumer and Industry Services, variable speed drives save up to 60% of the energy used by constant-speed systems, allow accurate control of flow, offer power factor correction, and increase the useful life of motors, belts, and pulleys. Savings from adding VSDs can be dramatic even with fairly heavily loaded motors. For example, a 100 HP motor driving a load continuously throttled to 80% of output will save almost $7,000 per year in electrical power costs when driven with variable speed.

Regional Coordination/Interaction with Other Policies

The DOE Best Practices program and the Northwest Energy Efficiency Alliance both have developed resources and outreach programs to reach industrial customers. These resources can be used to develop a program in any state. A key component of a successful program is to identify and target appropriately sized industrial customers. Identifying specific companies, that may benefit from the program, would need to be conducted state by state.

Required Action

To promote the use of variable speed motors in cooling tower fans in order to reduce peak electric demand and reduce electricity consumption, the following initiative elements would be required:

- Identification of industry targets: this involves the analysis of existing industry characteristics to determine the types and number of target manufacturers for the initiative.

- Training: training is required on two levels. The first is to provide training to contractors and other initiative implementation stakeholders in the identification and analysis of these types of opportunities. The second type of training is targeted at the prospective users of the technology, in the form of a series of workshops to explain the technology and its benefits, and to generate interest in its implementation.

- Outreach: this effort includes preparation of outreach materials (brochures, technical briefs) to accompany and complement the industrial workshops, and also target industrials not attending the workshops. It is expected that outreach efforts could be undertaken jointly with other agencies and/or with industry associations or chambers of commerce in the state.

- Demonstration and evaluation: states may wish to choose one or more prospective sites to demonstrate the application of this technology/strategy. A formal demonstration project can be established, with results widely distributed to other targeted industrials.

Major industrial sectors that could be included in this initiative are food processing, manufacture of machinery, electronics, and chemicals. While the commercial and institutional building sector is not a primary target of this initiative, many of these types of buildings also employ cooling towers to reject heat from chiller systems.

Energy Efficiency Best Practice
Industrial Compressed Air Energy Efficiency Programs

Description

Compressed air systems are widely used in industry for machinery, cooling, hand tools and materials handling. Compressed air systems can be 10 to 35 percent of the total electricity cost in many industrial sectors.

It is estimated that Compressed Air systems in the U.S. consume a total of 27 to 32 trillion Watt-hours (TWh) per year of energy. Using 30 TWh, and DOE efficiency improvement estimates of up to 50% potential reductions, energy savings could be realized in three major areas of AC systems, with the following breakdown:

Equipment package improvements	4.5 TWh
System design improvements	4.5 TWh
Operations & Maintenance improvements	6.0 TWh
Total	15.0 TWh

The goal is to establish programs to improve energy efficiency in the industrial sector by reducing the amount of energy consumed by industrial processes that rely on the use of compressed air.

Public Policy Rationale

Compressed air is considered by many to be among the industrial systems with the greatest potential returns for implementing energy efficiency practices and equipment. Because many industrial compressed air systems operate at only a fraction of their potential efficiency, there are excellent opportunities for energy savings. Industry could benefit both financially and from an environmental standpoint if these systems are made more efficient.

Examples of Implementation

- The Compressed Air Challenge (CAC) (www.knowpressure.org) is a voluntary collaboration of organizations promoting energy efficiency in industrial utilization of air compressors. Sponsors include DOE, Northwest Energy Efficiency Alliance, Honeywell, Inc., Consortium for Energy Efficiency, Compressed Air & Gas Institute, Pacific Gas & Electric, among others. The program includes training and development/dissemination of best practices in compressed air efficiencies. The latter includes a seven-step action plan for evaluating and improving existing compressed air systems.

  Part of the CAC program focuses on eliminating inappropriate uses of compressed air, such as: use of compressed air vortex tubes for cooling; for agitating and mixing; for parts cleaning; and to power simple hand tools. Through the seven-step action plan, the program also encourages compressed air audits to evaluate levels of air treatment, leaks, pressure levels, controls and regulators, load profiles and heat recovery options.

- The Compressed Air and Gas Institute (CAGI) (www.cagi.org) has a long history of working to improve the performance of compressed air systems in the U.S. CAGI has developed standards for these systems, including performance ratings for filters, dryers and compressors. Many of these standards are available through a searchable database accessible via the website.

- The SAV-AIR Market Transformation Initiative was a program established to seek changes in the way industry views and manages the use of compressed air. The program included commercial development of integrated systems for management of compressed air. Regional collaborators in the venture included the Northwest Energy Efficiency Alliance. The program was implemented from December 1998 through year-end 2000, and efforts to establish the program as a self-sustaining business are still ongoing.

- Examples of site-specific implementation of efficiency programs include the following: During 1998-99, Ford Motor Land Services and Detroit Edison collaborated on an efficiency improvement program for the compressed air system utilized at Ford's Woodhaven Plant. Examples of achievements within the first six months of the program include reduction of average scfm airflow requirements by 18% and reduction of correlated electricity costs by approximately $400,000 per year.

- During the past 10-15 years, many utilities offered rebates to customers for differential costs between standard and high efficiency Compressed Air systems. However, those programs have essentially been discontinued.

Political Feasibility

There are no political barriers to implementing compressed air energy efficiency programs. No action by state legislators or regulatory agencies is required.

Costs and Benefits

Compressed air (CA) is one of the most expensive forms of energy at an industrial facility. Annual electricity costs for operating a typical 100-hp compressor system can reach or exceed $50,000 per year, often eclipsing the acquisition costs of the system. Current U.S. CA systems are estimated to use 90B kWh of electricity annually, with energy costs of about $1.5B, and emissions estimated at 0.5% of the U.S. total. DOE studies estimate that 20-40% of this energy demand could be eliminated with energy-efficiency improvements.

For a typical compressed air system, every 2 psi increase in operating pressure incrementally increases applicable electricity costs by one percent. Conversely, this represents the expected savings from efficiency and maintenance measure reducing the required operational psi level for a system. These benefits are widely applicable since air compressors of 25 hp or more are estimated to account for more than 80% of the annual CA system power consumption in the U.S.

Leaks have been estimated to waste as much as 30% of a CA systems output and energy usage. This can be reduced to less than 10% with focused maintenance and leak detection systems. Each 1/8 inch leak in a CA system is estimated to represent nearly 42,000 kWh of wasted energy per year.

Interaction with Other Policies

Programs with incentives for accelerating installation of energy efficient compressed air systems or efficiency upgrades to existing systems, with resultant reductions in electricity demand would: assist in meeting regional haze reductions; and support any national energy policy initiatives for reduced power demand. Establishment of additional programs focused on air would advance existing efforts.

New efficiency programs would support and correlate with the 1992 the Energy Policy Act (EPAct), which applies to most industrial motors and stipulates that all covered products must

meet specified nominal efficiency levels. A modern system of 50-hp or greater can be expected to have efficiency rating of about 90%. However, EPAct nominal limits applicable to air compressor motors require efficiencies up to 95% for larger units.

Required Actions to Implement

National initiatives can be used as a source of information and technical assistance in the form of program design and implementation. Information and programs developed by the existing collaboratives can be used by a state to create their own program. States would need to undertake an assessment of the market opportunities and identify candidates for the program. States may choose to target various sectors based on the make up of industry in their state. The state energy office would be a likely entity to spearhead and effort to reach industry. A program may be strengthened by working with utilities in the area that have industry representatives that could deliver the message about the program and assist with implementation.

Energy Efficiency Best Practice
Industrial Pump and Fan Systems

Description

Industrial pumps and fans (including blowers) represent approximately 60% of total industrial electricity use. Pumps and fans are an integral component of just about every industrial sector. Major industries such as pulp and paper, water and wastewater, refineries, chemicals, and food processing use a majority of their electrical energy for motor driven pumps and fans. While there are large numbers of fans and pumps in place in these industries and a significant number of new units are sold each year, the majority of energy use comes from a small fraction of pumps and fans of significant size. For both fans and pumps, less than 20% of the equipment accounts for over 80% of the energy use. While pumps and fans are manufactured as relatively efficient pieces of equipment, in real application, motor driven pump and fan systems represent huge areas of potential gains in efficiency. Motor driven fan and pump system optimization offers 20% to 50% energy savings opportunities in many industries.

Public Policy Rational & Consistency with Deregulated Electricity Market

The current electricity supply situation in the West has placed industry in a very difficult position. Rate increases, particularly for those industrial customers who are paying market rates for electricity, have driven up production costs and in many cases threatened the continued market viability of some companies. Activity that assists those companies in finding and implementing motor system optimization strategies for pumps and fans will help reduce the effects of rate increases and help restore competitiveness to those companies. The significant quantity of efficiency resources available in this sector can also contribute to the needs of serving utilities that are supply constrained. Over the long term, increasing efficiency motor driven pumps and fans can improve profitability by reducing energy costs.

Examples of Implementation

A number of motor system optimization programs have been and are in place by government and utilities. The US DOE Best Practices program (formerly Motor Challenge) has and continues to develop case studies of motor system optimization for pumps and fans at industrial sites across the country. Regional programs such as the Northwest Energy Efficiency Alliance's Drivepower Program is also implementing motor system optimization activities. Specific optimization strategies (e.g. use of variable speed drives for variable loads) are often supported by utilities through financial incentive programs for purchase of VFDs.

Political Feasibility

The industrial sector represents an area that has been difficult, historically, for utilities and government to implement successful efficiency programs. Industry has complex decision making structures and low payback thresholds for incremental investments in efficiency. However, both original equipment manufacturers (OEMs) and the industrial engineering community have products and services available to provide increased efficiency in pump and fan operation.

Summary of Costs and Benefits

The implementation of successful programs for industrial pumps and fans will require the mobilization of OEMs and industrial consulting engineers. Political leadership in the West can facilitate progress in this area by encouraging industrial companies to analyze opportunities for motor system optimization in their facilities. The cost of this analysis is both industry and system specific. Using reasonable screening techniques, specific motor systems may be prioritized for more in-depth engineering analysis. The focus of the first efforts should be on large motor driven

systems with high annual operating hours. A number of these systems will likely yield energy and dollar benefits by employing motor system optimization strategies. These strategies will differ from system to system, but consistently be driven by re-engineering that better matches system design characteristics to process needs. Electrical energy savings of 20%-50% are routinely achievable by employing these techniques. The total energy savings to the Western grid are virtually imponderable, but are tied to the throughput capability in order to identify candidate systems and implement measures.

Regional Coordination/Interaction with Other Policies

This activity should be coordinated with national and regional motor system efforts (e.g. DOE Best Practices, Compressed Air Challenge, NEEA, utility program efforts). Promotion of these efforts is consistent with the move to electricity industry deregulation. In the future, service providers bidding for large industrial loads may offer efficiency analysis as part of their services.

Required Action

Success in this arena begins with mobilization of effort by public policy leaders to encourage industry in the West to find and implement motor system optimization strategies in their facilities. Without top down action in industry, savings will accrue to the West much more slowly. Original equipment manufacturers, industrial consulting engineers, and relevant industry and trade associations must be engaged to help increase awareness and deliver the necessary products and services to accomplish these efficiencies. This could include states offering technical assistance in the form of audits on specific facilities and the identification of the types of industries in the state that could be targeted for an efficiency program.

Energy Efficiency Best Practice
Industrial Steam System Energy Efficiency Improvements

Description

The purpose of this program is to encourage the efficient use of steam in industrial manufacturing facilities. A recent Arthur D. Little study prepared for ORNL ("Overview of Energy Flow for Industries in Standard Industrial Classifications 20-39," December 4, 2000) illustrated that, in 1994, about 34% of all industrial energy use was to create steam for process needs. The estimated total energy used for creating steam in industrial manufacturing processes was about 5,676 TBtu in 1994.

Many industrial plant operators are not aware that there are numerous opportunities available to improve the efficiency of industrial steam systems. Some of the typical areas for improvement include: a) improving boiler efficiency and fuel use; b) improved water treatment; c) repairing steam leaks; d) enhancing the maintenance of steam traps; e) improved efficiency of end use processes that utilize steam; f) installing and/or replacing insulation on piping systems; g) increasing condensate recovery; and h) improving overall steam system maintenance. Combinations of these and other potential steam system improvements can reduce a plant's total steam energy bill by 10% or more annually.

Public Policy Rational

Improving the energy efficiency of steam processes in industrial systems is good business. Not only does it lead to cost savings for the plant operations, it can often improve plant productivity, plant safety, and lead to reduced environmental emissions. Particularly in terms of reduced emissions, any improvements in steam system efficiency lead directly to reduced fuel use and reduced emissions.

Examples of Implementation

Case study write-ups on the implementation of steam system improvements for companies like ExxonMobil, Velsicol Chemical, Texas Petrochemical, Nalco Chemical, Georgia Pacific, Weirton Steel, Bethlehem Steel, and Babcock and Wilcox Technologies are available on the Department of Energy Office of Industrial Technologies Best Practices web site at www.oit.doe.gov/bestpractices.

Political Feasibility

There should not be any political issues with expanding efforts to improve the efficiency of industrial steam systems. These programs would be performed by individual businesses.

Summary of Costs and Benefits

If a total industrial steam energy efficiency improvement of 10% could be achieved, and if a fuel cost to make steam of $6/MMBtu is assumed, an annual steam energy cost savings of more than $3 billion dollars could result from improved steam energy efficiency.

Regional Coordination/Interaction with Other Policies

DOE BestPractices sponsors regional or company-wide training in the following areas: a) adjustable speed drive applications; b) pump system assessments; c) fundamentals of compressed air systems; d) advanced management of compressed air systems; and e) steam systems improvement. There are also some new training modules planned in the areas of: a) fan systems performance assessment; b) optimization of process heating systems; and c) motor systems

management. Using these training resources is one way to promote regional coordination and interactions.

A great example of a Western regional event that is already planned, is the DOE Showcase event that will occur in Salt Lake City, Utah in late August 2001. This Showcase will highlight DOE and plant technologies and energy efficiency best practices in a number of Salt Lake City mining, aluminum, and petroleum refining plants.

Required Action

The first step for states to take to make steam system improvements is to become aware of the resources that are already available to them through the Department of Energy Office of Industrial Technology BestPractices program. The BestPractices web site includes downloadable steam energy tip sheets, case study write-ups, and technical tools that can be used to assist in improving industrial steam systems. The DOE-OIT BestPractices web site address is www.oit.doe.gov/bestpractices.

States can work with the Department of Energy to identify potential clients for the program. States can work at the local level with utilities to encourage industrial customers to attend seminars and participate in improvement programs.

Energy Efficiency Best Practice
Combined Heat & Power (CHP) Industrial Program

Description

The Combined Heat and Power (CHP) program encourages new and existing industrial facilities to install equipment to meet their electrical and thermal loads. A CHP unit uses the waste heat produced by an electricity generation system to produce steam or hot water that can be used in manufacturing processes. CHP systems include natural gas, diesel fuel, oil, and coal powered electric generators (e.g. gas turbine and internal combustion engine driven generators, steam turbines, and fuel cells) heat recovery heat exchangers, and absorption chillers. CHP systems are very effective in manufacturing facilities where there are simultaneous requirements for heat and electricity.

Of all the current applications of CHP, the manufacturing sector has the most experience with combined heat and power systems. CHP has been highly successful in the paper, chemical, food processing, metals and refining industries because they are large power users with a great demand for process heat. According to a Market and Technical Potential for Combined Heat and Power in the Industrial Sector <A HREF=http://www.eren.doe.gov/der/chp/pdfs/eiaind.pdf >report prepared by Onsite Sycom, for the Energy Information Administration, existing industrial facilities currently have installed only one−third of the total potential CHP. They estimate that the range of potential is 75,000 to 100,000 megawatts. Further the study shows that over 90% of the installed CHP is in systems of 20 MW and larger.

Public Policy Rational

Capturing and using the thermal energy produced as a by-product from fuel sources such as oil, coal, or natural gas increases the power gained from the original fuel source. Conventional electricity generation converts only about a third of the fuel's potential energy into usable energy. There is a tremendous efficiency opportunity to combine electricity generation with thermal loads in buildings and other commercial facilities - converting as much as 85 percent of the fuel into usable energy. CHP technologies can reduce energy consumption, decreasing energy bills as well as pollution. These technologies should be supported based on the fact that they make more efficient use of our natural resources, can reduce emissions and are already in use and accepted in industrial applications.

Another appealing benefit of installing new CHP systems is that they decrease demands on the existing electricity grid and reduce peak.

Examples of Implementation

Anderson Lithograph uses a 3.9 MW gas turbine in a combined cycle plant to produce electricity and medium temperature steam that drives both a 1.2 MW back pressure steam generator and 1300 tons of absorption chillers. Innovative design also enabled destruction of volatile organic compounds from recycling photographic chemicals through direct combustion in the gas turbine. For additional information on case studies click here at http://www.bchp.org/applications/case.html.

Political Feasibility

Obstacles face CHP systems that are both technical and political in nature. These include addressing safety issues raised by electric utilities concerning interconnecting with the existing grid, exit fees for abandoned capacity when commercial sites go off the grid, rates for standby

power needed during scheduled and unscheduled maintenance of on site generators, and air quality permit requirements among others. However, many successful installations show that building owners and contractors can work with utilities, public service commissions, and permitting boards to overcome these obstacles.

Up front costs and operation of more complicated physical plants deter many facility managers from proposing and installing CHP systems. While some companies fully fund projects in-house, other installations result from partnerships between private companies, government installations, energy service companies (ESCOs), and utilities, with each participant sharing in the savings. State and federal governments provide valuable assistance with preliminary proposals and developing partnerships to fund projects.

Summary of Costs and Benefits

The EIA CHP Report, sited above, lists the cost and efficiency characteristics for the types of CHP plants.

	Recip Engine	Steam Turbine	Combustion Turbine	Combined Cycle
Electric Efficiency (LHV)	25-45%	15-25%	25-40%	40-50%
Size (MW)	0.05-5	any	1-100	25-300
CHP installed cost ($/kW)	800-1500	800-1000	700-900	600-800

Portion of Table A-1 The Market and Technical Potential for Combined Heat and Power in the Industrial Sector, EIA, Jan 2000

Regional Coordination/Interaction with Other Policies

CHP projects are, and will continue to be, affected by distributed generation policies developed throughout the states and at the federal level. CHP projects will benefit from standardized interconnection standards and contracting processes, and reduced installation costs as distributed generation applications become more wide spread.

CHP development efforts should be coordinated closely with the Department of Energy CHP Initiative. The Initiative raises awareness of the energy, economic and environmental benefits of CHP and highlights barriers that limit its increased implementation. The Initiative supports a range of activities including regional workshops, industry dialogues and development of educational materials.

Required Action

The first step is for states to recognize and analyze the potential benefits of CHP. A concerted effort focused on industry must be undertaken to identify sites for implementation. Using the technical assistance program developed by the Department of Energy, states can create similar programs geared toward local industry. States may need to identify a funding source to provide the incentive to interest industry in CHP installation. States should also review utility and public utility commission policies on distributed generation to determine if there are impediments to the development of these types of systems.

Energy Efficiency Best Practices
State Tax Incentives

Description

Government can use tax incentives to influence household or business buying decisions toward more energy-efficient alternatives. The forms of incentives include income tax credits, sales tax credits, and property tax credits. Tax incentives need to be carefully crafted to produce the desired effect. If set too low, they may not encourage the desired outcome. If set too high, they can create artificial markets that drain a state's budget and are not sustainable.

Public Policy Rationale

Tax incentives are a favored form used by government to change a marketplace to yield social benefits such as improved economic health, more affordable housing, reduced pollution, or the conservation of stressed natural resources. Tax incentives reduce a government's revenue stream, but are often more feasible than providing up-front funding for investments. Successful incentive programs must be available to a wide spectrum of households and businesses. States with abundant energy supplies may be less interested in offering tax incentives for equipment and services that reduce energy use.

Examples of Implementation

Oregon offers income tax credits to encourage households and businesses to invest in energy conservation, renewable resources, recycling, and alternatives. Oregon's business energy tax credit is 35 percent of the cost of the investment. The credit is taken over five years (10 percent in the first and second years and 5 percent each year thereafter). For conservation measures, the energy savings must pay back the cost of the investment in more than one and less than 15 years. Tax credits have gone to a wide range of businesses for a variety of investments in energy efficiency, including the following:

- Manufacturers for improving the energy efficiency of their production processes.
- Farmers for installing energy- and water-saving irrigation systems.
- Landlords for weatherizing their apartment buildings.
- Department stores for putting in efficient lights.
- Restaurant owners for installing waste heat recovery systems.
- Commercial business employers for buying bus passes for their employees.

Oregon also offers income tax credits to households for investments in energy-efficient appliances, high-efficiency space and water heating systems, and alternative fuel vehicles. The credit ranges from $150 to $1,500 depending on the type of system.

Political Feasibility

Enactment of tax incentive legislation will depend on the nature of the state legislature and the benefits and the revenue impact of the incentives. To build support, legislators, civic leaders, and the business community, must be educated on the short and long-range benefits of offering tax incentives for conservation and efficiency technology. This education process may take several years.

Summary of Costs and Benefits

As an example, Oregon's business energy tax credit program has stimulated projects that save an estimated 13 trillion BTU at a total cost to the state of $450 million.

The impact of incentives will vary widely depending on the number of types of equipment offered incentives, audience(s) for the incentives, and duration and level of the incentive. A benefit of incentives is that states can tailor programs to offer very specific incentives on one type of equipment or activity or, as in Oregon, offer a comprehensive set of incentives. A disadvantage of tax credits -- as opposed to a rebate -- is that the cost of the incentive will not be known until the end of the tax year when credits have been claimed.

Regional Coordination/Interaction with Other Policies

Government tax incentives complement energy-efficiency programs offered by utilities and other entities. Tax incentives will work in a deregulated electricity environment, because incentives are usually offered statewide throughout all the utility service territories.

If tax incentives are offered for Energy Star or other branded product programs, incentives can be consistent across the region.

Required Action

State legislation is required to pass income tax credits, sales tax credits, or property tax credits. In most cases these types of incentives may take several years to build support necessary for passage. The first step would be to identify good targets for energy efficiency such as commercial, industry or residential buildings, or agriculture. A coalition of supporters should be built that can work to educate elected officials about the costs and benefits of providing incentives for energy efficient products or practices.

Energy Efficiency Best Practice
Public Purpose Funding

Description

To encourage energy efficiency and energy conservation projects, funding can be made available to stimulate development of these projects. To ensure longevity of programs, a dedicated source of funding is desirable. Two methods used to create a dedicated funding stream for energy conservation and efficiency projects and programs are ratepayer funds and system benefit charges.

Ratepayer funds would consist of a "tax" on energy consumed by a utility customer. Funds collected could be utilized by a utility to conduct rebate and conservation programs or they could be deposited in a state fund to be administered by the state or other designated agency.

System Benefit Charges (SBC) are similarly collected from electric consumers based on the amount of energy consumed. Funds collected are earmarked for programs that benefit the public. SBC have been created in many states as part of electricity restructuring.

Public Policy Rational & Consistency with Deregulated Electricity Market

Public purpose funds, in the form of ratepayer funds, have historically been used to support a variety of programs that are deemed worthy of public support. Funds have been provided for: programs which assist low-income customers pay their utility bills and for efficiency improvement of their residences (weatherization); traditional demand side management programs; developing and investing in renewable energy resources; and other conservation programs. Conservation of electricity is worthy of public support, because reductions in energy use reduce environment degradation caused by power production. SBC are a method to charge consumers for the environmental degradation resulting from energy consumption.

SBC are largely new, having come into being as a result of restructuring the electricity market. The SBC funds are being used for many of the same programs as ratepayer funds, however, a greater variety of programs may be funded by SBC.

Examples of Implementation

The state of Oregon, under its restructuring law, charges a 3 percent fee to all electric customers and gets deposited in a public purpose fund. The fund is then used to support conservation efforts, low-income weatherization programs, and to develop renewable energy resources.

In Montana, public purpose funds are raised by charging consumers 2.4 percent (based on a utility's 1995 retail sales revenue). The state and utilities spend the funds on conservation, efficiency, and renewable energy programs.

New Mexico collects 0.3 mills per kWh to support investment in renewable energy development. Funds are not provided for other public purpose programs.

In Arizona, a system benefit charge is collected to support nuclear power plant decommissioning programs, nuclear fuel disposal, renewable technologies, low-income, and demand side management programs.

Political Feasibility

Historically, public purpose funds have been used to support programs that are deemed beneficial for the public at large. The major source of debate in most states that have contemplated system benefits charges, as a result of restructuring, has centered on the amount of funds that should be collected and what type of programs should be eligible for funding. In many states throughout the west funds have been dedicated for the development of clean renewable energy resources as well as more traditional programs such as bill paying assistance and weatherization programs. Evaluation of potential programs using a cost benefit analysis may help justify development of public purpose funds. However, it must also be balanced with the political appeal of a program.

Summary of Costs and Benefits

The cost and benefits resulting from establishing SBC or ratepayer funds will be program specific. Proper analysis in the form of cost/benefit or life cycle costing, can provide the assurance of a net positive expenditure of public purpose funds. Each program considered for funding should undergo an analysis to determine its rank in benefits. From such a list, states can prioritize spending from public purpose funds.

Regional Coordination/Interaction with Other Policies

Unless the federal government moves to impose a national system benefit charge of some kind, states would implement public purpose funding programs on a state-by-state basis. There is little room for regional coordination since these funds are created and expended by each state. In some areas, such as low-income programs, many states have the same or similar programs. However, funding for renewable energy and conservation programs varies widely from state to state.

Public purpose funds are crucial to the development and continuation of future conservation and efficiency programs. In fact, without these funds, many programs could not exist.

Required Action

Ratepayer funds can be difficult to create or increase, because they are a new tax on electricity users. To create or increase funding levels a broad coalition of stakeholders would need to be developed. Some of the policy decisions that would need to be made would be the amount of tax, what type of programs it would support, and which entity would be responsible for administering the money and program. Passage of a mil charge may take several years.

States that are restructuring their electricity markets have an opportunity to create a SBC. This has been done by many states throughout the west. Creating a SBC is especially important if traditional sources of funding for conservation, efficiency, and low-income programs would be eliminated as a result of restructuring. A wealth of information is available to states considering SBC from states that have existing SBC.

Energy Efficiency Best Practice
Data Mining for Improved Load Forecasting and Targeting Maximum Energy Savings and Demand Reductions

Description

Electric and gas utilities across the western United States collect and maintain extensive meter data reflecting actual energy usage for individual electric and gas end-use consumers to support accurate customer billing. The installation of advanced metering technology to support time-of-use and real-time pricing rate programs, increasingly offers refined temporal and location specific detail. This data would be very useful for improved geographic load forecasting and subsequent targeting of available energy efficiency and demand reduction program funding to the most promising near-term end-use reduction opportunities. These data can be mined by utilities and/or state regulators to target specific regions or major customers (by class or individually) with conservation and efficiency programs. In essence, this amounts to a rigorous search for the "lowest hanging fruit".

Outmoded load-forecasting techniques and data are largely responsible for the failure of utilities and state regulators to accurately predict recent rapid demand growth over much of the Western System Coordinating Council (WSCC). End-use load forecasting in a supply-rich market has traditionally relied on standardized representations of statistically aggregated generic customers classes, which lack refined understanding of variability within customer class or across geographic localities that may be subject to unique supply, transmission or distribution constraints. For example, northern California load forecasts use standard profiles across entire service areas for each customer class; these do not reflect the considerable geographic variability or vast range of energy intensity within broad customer classes as they have evolved in the information age.

Aggressive data mining programs in each state would lead to vastly improved regional load forecasts within the WSCC. Analyses of both electric and gas usage data could identify promising trade-off opportunities that might mitigate price and supply volatility in both commodity markets. More refined data would also provide unprecedented capability to more precisely target public energy management program funding to maximize effectiveness. These valuable data could also be sold to competitive energy service providers in emerging retail markets on a non-discriminatory basis to support more effective marketing and business development efforts that would open retail markets faster.

Public Policy Rational and Consistency with Deregulating Electricity Market

Public utility commissions and utilities rely upon energy use information to design and implement energy efficiency and demand reduction program and to develop load forecasts. Typically the data being used is in aggregated form that may not allow differentiation of different customer classes and regions. If disaggregated (more exact) information was allowed to be used energy efficiency and demand side management programs could be more carefully crafted and targeted to potential customers. Current practices may not be identifying the most cost-effective program because of the "garbage in – garbage out" principle. If assurances and safe guards were put in place to protect the consumer the more accurate data would provide superior information to work from which would result in better less costly programs.

Examples of Implementation

The California Energy Commission initiated an ambitious program last summer to improve state electricity load forecasting models (e.g., HELM) and refine underlying data to improve accuracy.

Actual meter data are not being used in this study, nor are refined load forecasts proposed for use to target demand reduction or energy efficiency program funds administered by the State.

Political Feasibility

Many state utility regulators have prohibited utilities from using actual disaggregated customer energy consumption and metering data as a basis for more accurate load forecasting and targeting of end-use energy management programs and incentives. The justification for this has been both to protect the confidentiality of customer data against potential marketing abuses, and also to insure non-discriminatory access for all customers in a particular class or region to publicly funded programs. This dynamic must be changed by educating commissioners about the added benefit of collecting and using more accurate data. Commissioners and regulators would need to develop assurances and safeguards to protect the public.

Summary of Costs and Benefits

Cost savings from data mining programs are very difficult to predict accurately, but would be substantial. Their main value is in dramatically improving the market penetration, cost-effectiveness, and measurable results of publicly funded or competitively driven demand reduction programs. Selling refined customer usage data on a non-discriminatory basis also could be an important source of revenue for regulated utilities and/or state regulatory agencies to offset or subsidize other ratepayer costs.

Regional Coordination/Interaction with Other Policies

To begin a data mining program advanced meters must be installed that would need to be done by each service provider. However to ensure that data is usable for a public utility commission or regulatory agency standards and methodology must be set up that is consistent statewide. This is also true for policies that will protect public interests. For load growth analysis across the WSCC region consistency will be important throughout all states. Public utility commission can work together to develop guidelines that will provide consistency.

Development of data collection and public protection procedures must be considered as a state is developing its process to deregulate the electricity market.

Required Action

To begin the process of data mining a team must be established in each state to acquire existing utility meter data and begin data analysis. Data mining would be an ongoing activity. Meaningful initial results could be available within as little two months to achieve improved load forecasts (reduce supply imbalances) and targeting of demand reduction measures.

Legitimate concerns over potential abuses of customer confidential data require regulatory oversight for all data mining efforts. State agencies or regulated utilities could establish data analysis teams to acquire, manage, and analyze customer data by usage class and region. Existing data management systems could be used to minimize costs and reduce time to achieve meaningful results.

Energy Efficiency Best Practice
Sending Consumer Accurate Price Signal Program

Description

The average electricity consumer has little knowledge of the cost of producing electricity and about how much energy they use, at what time of day. The typical ratepayer is charged a standard summer or winter rate for each kilowatt-hour of electricity consumed. However, the utility's cost for purchasing or producing power fluctuates based on the daily, hourly, and seasonal supply and demand for electricity. Since consumers usually see a flat rate, there is no incentive to conserve or change habits to use less electricity or use electricity during off-peak hours. Consumers can be provided more information about the true cost of electricity to encourage them to conserve or consumers can be charged or shown the actual or near actual price for their electricity use. There are a variety of methods to show or charge consumers the true cost of their power usage. These include:

- Installation of "real-time" electrical meters which allow customers to see and a utility to bill based on the price of electricity at the hour of use. This requires the installation of a new meter at the home that can be costly and time consuming for a utility. These meters can charge customers based on the actual usage by hour.
- Time of use (TOU) meters are similar to real-time meters, however, they are typically used to charge customers for on-peak and off-peak usage. Some TOU programs also have pricing for shoulder usage. TOU meters are in limited use around the country.
- Voluntary off-peak power rate programs are well established across the nation. Consumers on these types of rate plans receive a discount on their off-peak or shoulder power consumption and are charged a premium if they exceed an established threshold of on-peak power use. Consumers in this program are generally knowledgeable about their energy usage patterns.
- Inverted block rates customers are charged a certain amount for each established amount of energy consumed. As power usage increases, each "block" of energy consumed is priced at a higher rate than the previous one. This provides an incentive for conservation over a flat rate, because the more a consumer uses the more they are charged per block. This rate structure is the opposite of existing block rates that usually provide less expensive rates for additional energy use.
- Shadow pricing is where a utility provides information on the utility bill as to the real cost of the power consumed. This would provide information to the consumer on the real time or time of use pricing for their electricity to encourage conservation. Shadow pricing could be used as a lead into real-time pricing. As with all other programs it would require the installation of a new meter. However, it may be cost prohibitive for utilities to install a meter just to provide information to consumers.

Each of these signals would educate the consumer about their electricity use and its true cost. If the real cost (on/off-peak and seasonal) of electricity is seen by the consumer, there is an incentive for users to reduce their overall demand for electricity and/or shift a portion of their electricity use from on to off-peak.

Public Policy Rational

Utilities incur tremendous expense to purchase or build enough capacity to meet peak load. In normal circumstances the load peak is a few hours every day. Conservation of energy at peak load will reduce or delay the need for costly new generation facilities or help avoid purchase of expensive wholesale power. Reducing these capital or procurement costs will provide lower total

operating cost for a utility and could impact the rates charged to consumers. Many times plants operated to serve just the winter or summer peak can be older, less efficient, and more polluting power plants. Reducing peak will reduce the need to operate these more costly and environmentally damaging power generation facilities.

Examples of Implementation

Georgia Power has offered a time-of-use rate since 1994. In June through September customers are charged 17.5 cents/kWh on-peak and 5.4 cents/kWh off-peak. On peak is 2p.m. to 7 p.m. weekdays. For October through May, customers are charged 5.4 cent/kWh for the first 650 kWh and 3.0 cents/kWh for over 650 kWh. Customers are also charged a $10 monthly service fee.

Puget Sound Energy operates a time-of use rate where residential customers are provided with meters that are remotely read. Customers pay a rate that changes depending on the time of use. Kilowatt hours used during 6 a.m. to 10 a.m. and 5 p.m. to 9 p.m. is priced just under a penny more (.9 cent) higher than their current rate. Night time kilowatt use (9 p.m. to 6 a.m.) is charged at just over one-half cent less (.65 cent) than the current rate and use during the day (10 a.m. to 5 p.m.) is at the established rate. It is expected that customers with monthly usage equal to the average residential customer would experience no change in their bill as a result of this time-of-use program. The Washington Utilities and Transportation Commission staff projected that 96 percent of time of use customers will realize a change in their bill of less than 3 percent if they make no change in their current electricity use habits. Customers are allowed to return to the old flat rate structure if desired.

Southern Company of Florida and Georgia is operating a pilot program where customers have installed a thermostat-looking device that provides signals for four pricing regimes that will be in place from time to time. Two of the price regimes are lower than the average price, and two are higher. One of the pricing schedules is much higher at 29 cents/kWh. In some cases the devices disable some loads within the home.

Political Feasibility

The change from existing rate structures to structures based on cost of energy will be controversial if citizens see an increase in electricity costs. All of the accurate price signal programs are geared to educate consumers about their consumption habits. Understanding more fully the cost of power at different times during the day will encourage some customers to modify their behavior. Moving to rate structures mentioned above would make a utility bill more complicated which may confuse consumers.

Utilities have offered various voluntary rate structures for years offering varying degrees of acceptance and participation. Implementing these new rate programs will be effective in reducing consumption, but instituting these programs must be approached with caution.

As the electricity markets are opened to competition these programs may become more prevalent. Utilities may show great interest in encouraging consumers' conservation and off peak power use through the use of accurate price signal rate structures. Utilities that are competing may design and implement a host of new rate plans to offer to their consumers.

For customers that have high daytime loads, changing to time of use or real time rates will result in higher costs unless the customer changes its operation. Large and small consumers may be deterred from using these alternate rates and resist required use of these rates because of financial impacts. Although some companies will benefit from these types of rate structures, many will not.

Summary of Costs and Benefits

Reduction in peak load can provide tremendous benefits to utilities since the cost of purchasing or producing power at peak hours is the most expensive. Unless customers modify behavior to consume more electricity during off-peak hours, they will see a raise in electricity costs if they are on a rate that charges a higher amount for peak power usage.

Regional Coordination/Interaction with Other Policies

Sending accurate price signals to consumer would create the foundation or impetus for a broad range of energy efficiency and conservation programs and efforts. If consumers are more educated about, or are charged the actual cost of power they consume, they will be encouraged to change habits and usage patterns. For example, consumers may become more interested in energy efficient appliances that use less energy or they may make energy improvements to their home to reduce energy use. Implementing these programs would radically change the dynamic for the residential energy consumers. It would eliminate the status quo of using as much electricity as desired for a flat rate. These rates may be the most effective policy for conservation in the residential sector.

Required Action

All the types of rate structures mentioned above would typically need approval of the public utility commission or board governing the utility. If these programs were anything but voluntary extensive public policy debate would be required. If voluntary, a utility would need to design the rate structure, receive approval, and advertise the rate to consumers to encourage voluntary participation.

Energy Efficiency Best Practice
Government New Construction and Design Standards Program

Description

State government typically uses low-bid procedures for design and construction of new commercial buildings. Under this system, initial costs of a building are used to determine what type of equipment and envelop is built instead of looking at the life cycle cost of the building over its useful life. Buildings designed with energy efficient features may be more expensive to construct, however, operation and maintenance is less. The 1992 Energy Policy Act required that states consider adoption of the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) 90.1 –1989 standard for commercial buildings. If states have this standard in place (nine WRAP states do), the code can be updated by adopting the International Energy Conservation Code (IECC) (see Building Codes and Standards). The IECC is based on the 1999 version of ASHRAE.

States have the option of adopting codes that exceed AHSRAE or adopting "green" building standards that add an environmental component. The Leadership in Energy and Environmental Design (LEED) standard is a point-based code that gives credit for water conservation strategies, use of recycled materials, actions that reduce air pollution, energy conservation, and a variety of other factors. The Federal Energy Management program has a Low Energy Design standard currently in use for federal buildings, which could be used by states.

For public buildings, adoption of energy efficiency or environmental standards can be done through Gubernatorial Administrative Order, then enacted by the state legislature or implemented as policy by the administrating agency.

Public Policy Rational

Constructing government buildings using an energy efficiency standard make sense because, although higher in start-up costs, government will save money in the long term -- making owning and operating buildings more cost effective. Leading by example is the second reason government should adopt some type of building standard. Government can create a pull on the market for efficient buildings by creating a demand for energy efficient design and construction through the adoption of a code.

Examples of Implementation

The State of Pennsylvania Department of Environmental Protection was one of the first governmental entities to construct an office building using the LEED standard. The new 26,770 square foot building exceeds the ASHRAE building standard by 20 percent, by incorporating advance lighting, monitoring and control, and HVAC measures. According to the Governor's Green Government Council based on simulation, energy costs will be reduced from $1.54 per square foot for a conventional-designed building to $0.74 for their building. The resulting 50 percent savings translates to a reduced annual energy cost of approximately $50,000.

Political Feasibility

Establishing policy for state building design and construction that incorporates energy efficiency may require educating the legislature, who typically authorize funding for government facilities, agency personnel responsible for design and construction, and the Governor. Instituting an IECC, ASHRAE, LEEDs or other code requirement for publicly funded buildings, should be politically feasible based on long term economics. States may run into problems if the budgeting process does not look beyond initial costs.

Summary of Costs and Benefits

The savings associated with the adoption of a building standard for government buildings will vary widely depending on the type of standard adopted. Savings will be greater for states adopting codes for the first time. According to the Department of Energy, the 1999 ASHRAE standard reduces source energy consumption in a building by six percent over the 1989 standard. States adopting a more stringent standard like the LEED standard can achieve a greater percentage saving.

Regional Coordination/Interaction with Other Policies

Adoption of an energy efficient or low energy design standard will mesh with other efforts to reduce, streamline, or make government more efficient. Adoption of these policies will augment initiatives to have government lead by example.

Required Action

Adopting an energy efficiency standard for public buildings should be done through the path of least resistance. If the agency director in charge of facilities has the authority to implement an energy efficiency requirement or adopt a standard, this may be the quickest and easiest way. An executive order, issued by the Governor, may be the second fastest method. Adoption of energy standards by the Legislation may be the slowest way to proceed, but it would have the force of law.

States considering adoption of a standard should conduct an evaluation of the various types of codes and their effectiveness and feasibility. Once a standard is chosen, a code compliance method should be incorporated to ensure that all state-funded buildings meet the adopted standard. Once a code has been adopted, state design and construction personnel must be educated. Education and technical assistance is available through the ASHRAE that offers training classes on understanding and using their code. States can also utilize assistance programs offered by the Building Code Assistance Project and from the U.S. Department of Energy.

The ASHRAE has instituted a policy of continuous maintenance for updating codes instead of a 10-year comprehensive review. States will also need to create a mechanism to periodically update the adopted codes. This could be done on an annual or less frequent basis.

Energy Efficiency Best Practice
Public Building Audit and Retrofit Program

Description

Public building audit and retrofit programs are usually conducted in stages. In the first stage, a government agency retains an energy audit firm or uses existing staff to study specified buildings and to identify energy efficiency and maintenance improvements that could be completed economically. In the second, the agency identifies the improvements it would like to install or implement and retains whatever service providers, if any, are needed to complete the work. If using contractors often one provider completes both stages, typically an Energy Service Company (ESCO). Public building retrofit programs have been funded differently across the country. Some public building retrofit programs are funded by government bonds, some by revolving loan accounts, some by grants or appropriations and others use private capital arranged by the ESCO. Generally, agencies implement only those measures that pay for themselves through savings. In some public building retrofit programs, energy efficiency measures are reviewed individually while in others the recommendations are aggregated for the entire building. On campuses or where a single agency owns or manages a number of buildings, recommended energy efficiency improvements are often pooled across buildings and analyzed. Most energy efficiency improvements in public buildings are comparable to the ones installed in commercial offices, i.e., efficient lighting, space conditioning and building envelope improvements. Program costs could be cost shared using Universal System Benefits funds or other utility operated energy efficiency acquisition program monies.

Public Policy Rational & Consistency with Deregulated Electricity Market

Throughout the west states do not typically provide adequate funds for maintenance and upgrading of state facilities. Like commercial buildings, many state facilities may have old mechanical equipment and which may not be operating at optimal conditions. For government to be able to encourage energy conservation and efficiency it is good public policy to have state buildings in good condition. An audit and retrofit program will provide the information needed to determine the most cost-effective actions to take. Improved building efficiency will increase occupant comfort, reduce maintenance and operating costs and reduce utility bills and pollution.

Examples of Implementation

The state of Texas operates a program called LoanSTAR. State agencies, schools and other public entities can apply for loans to make recommended energy retrofits. Participants must repay the loans in four years or less based on estimated energy savings. In most cases repayment is made from savings generated by the cost-effective retrofit measures. State agencies are also authorized to repay these loans from general revenue funds budgeted for utilities. Once the loans are repaid, the savings are available for the agencies. Before the retrofits can be installed, a building must be audited for its energy use and efficiency. Once the retrofits have been approved, LoanSTAR Consortium personnel install monitoring equipment and begin measuring energy use for each building.

The state of Arizona conducted an energy retrofit project between April 1993 and June 1996. The Energy Office worked with the Department of Administration (ADOA) to make energy improvements to ADOA managed buildings. Approximately 1.6 million square feet of buildings at the Capitol complexes in Phoenix and Tucson were retrofitted in this project. $4.5 million from the petroleum restitution fund (oil overcharge), $120,000 from ADOA building renewal and $80,000 from utility rebates provided funding. The savings were more than $900,000 per year with the improvements expected to last 20 years.

The state of Montana operates the State Buildings Energy Conservation Bond program to finance energy improvement projects on state owned buildings. The Montana Department of Environmental Quality administers the program which uses bond proceeds to fund the projects and energy savings to repay the bonds. The state of Montana encourages agencies to participate in the program to achieve available energy savings.

The State of Iowa created the Facilities Improvement Corporation (SIFIC), a nonprofit corporation that helps state agencies implement cost-effective energy efficiency improvements. In 1986 the SIFIC was incorporated and $12,245,000 in energy conservation revenue bonds were sold. The proceeds from the sale were used to acquire energy improvements for public buildings. To date, SIFIC has saved more than $22 million in energy costs and more than 400,000 tons of emissions. Iowa has one of the premier state facility energy efficiency programs because of their funding commitment.

Political Feasibility & Consistency with Deregulated Electricity Market

The biggest obstacle to implementing a public building audit and retrofit program is to obtain funding. States have chosen various methods to fund retrofit projects. Based on the possible payback these projects are sound investments for the states. State legislatures or state government entity must decide the best financing mechanism for their state. In several states bond or loan programs have been established which requires a tremendous amount of up-front work to establish the program. The advantage of these programs is that they are long lasting because they can provide revolving or perpetual funding. States that use grants or appropriations may have finite programs unless energy savings are allowed to be rolled into more projects. Auditing and retrofitting of public facilities is consistent with the move to a deregulated electricity market. In fact as the market is opened to competition there may be more opportunity for states to work with service providers to design and fund public building programs.

Summary of Costs and Benefits

The state of Texas has generated $83 million in savings from their LoanSTAR program (as of March 2000) and it is projected to save another $250 million over the next 20 years. One project was the retrofitting of the air handling system in the 324,000 square foot Zachary Engineering Center (ZEC) at Texas A&M University campus. The project saves as much as $25,000 per month. Texas A&M has not been the only recipient of energy savings. Sixteen buildings at the University of Texas have also been retrofitted. UT's energy bill decreased 30% as a result of its retrofits. Texas State Energy Conservation Office, The Texas LoanSTAR Program http://www.esl.tamu.edu/loanstar/about_LoanSTAR.html.

The measures, costs and savings for Arizona's program are listed below.

Measure	Quantity	Capital Cost	Est. $ Savings	Simple Payback
Lighting	22,872	$1,165,000	$380,000	3.1 years
Chillers	21	$2,489,000	$350,000	7.1 years
Plate & Frame	6	$200,000	$30,000	6.6 years
Motors	93	$89,000	$17,250	5.2 years
VFDs, VAVs, etc.	32	$757,000	$125,000	6.0 years
Totals		**$4,700,000**	**$902,250**	**5.2 years**

In one Iowa project the Department of Transportation spent 1.1 million dollars on lighting, an EMS system, new chillers and O & M changes in 13 buildings totaling 400,000 square feet. Annual savings have exceeded the projected $225,000 per year. In addition, estimated savings

from operation and maintenance changes are more than $63,000 annually. The program had a six year payback. Many of the programs funded by the State of Iowa Facilities Improvement Corporation have a six year payback or less. Iowa Department of Natural Resources, Building Energy Management Programs http://www.state.ia.us/dnr/energy/programs/bem/index.html.

When money is spent to implement energy savings, the economic multiplier greatly increases the benefits of installation. For example, payments for electricity have a multiplier of $1.75, for every $1 spent $1.75 is generated in a community. The multiplier for energy conservation is $2.32 according to a 1984 report by the Nebraska Energy Office – *Community Energy Management as an Economic Development Strategy.*

Regional Coordination

Public building audit and retrofit programs do not need regional coordination rather they should be implemented state by state. There is tremendous experience with these types of programs throughout the nation so states can review the various type of financing mechanisms and program designs to determine the best match for their state.

Required Action

Program implementation strategies will differ based on whether existing programs are already in place. There are numerous good model programs states could mimic and all federal facilities can be addressed through the Federal Energy Management Program. The Energy Information Administration conducted the Federal Buildings Supplemental Survey in 1993 to determine how federal buildings use energy. This data is available at http://www.eia.doe.gov/emeu/cbecs/pubfbss.html.

To create a program states will need to:

- Conduct an assessment of current building conditions
- Review other state programs
- Determine the types of public buildings to be included in the program (school, state, municipal, etc.).
- Determine the most politically feasible or available stream of funding for projects
- Establish the entity which will be responsible for program design and administration
- Work with policy makers and other elected officials to gain support for the program
- Once established, determine methods to advertise and encourage participation in the program.
- Create a system to monitor and evaluate projects.

Energy Efficiency Best Practice
State Facility Performance Contracting

Description

Performance contracting (PC) is a comprehensive approach for providing energy efficiency savings for end use customers, particularly those in the commercial and institutional sector. Energy service providers (sometimes referred to as ESCOs) implement a comprehensive set of energy services beginning with a scoping of project opportunities, extending through an engineering audit, in some cases financing, installation of measures, and ongoing operations and maintenance. In many instances, this arrangement includes some type of savings guarantee. Performance contracting works especially well in situations where there is occupant stability in the facility, such as schools and public buildings.

Public Policy Rational & Consistency with Deregulated Electricity Market

States are large property holders owning and occupying office properties, universities and community colleges, water and wastewater treatment facilities, prisons, parks and recreation facilities, and other structures. Consequently, state government in all Western states is a significant user of electrical energy resources. Leadership in the efficient use of energy by the public sector contributes to at least three policy ends including; 1) wise use of public funds, 2) significant savings for the serving utility(ies), and 3) leadership by example.

Examples of Implementation

Every state in the West has successful examples of performance contracting in public buildings. This approach has worked successfully with state owned facilities, water and wastewater treatment facilities, prisons, and colleges and universities. Energy service providers offering performance contracting in the West are active in all states and are represented by organizations such as the National Association of Energy Service Companies (NAESCO), the Energy Services Coalition, and the Northwest Energy Efficiency Council (NEEC). Each of these trade associations has examples of successful performance contracting.

Political Feasibility

Of all proposed efficiency program efforts, this activity may be the most near-term viable and easiest to implement. Performance contracts provide the benefit of improved facilities while many times not requiring out-of-pocket costs to initiate the work. Energy performance contracted services are paid for through energy savings achieved. State elected officials may choose to encourage or even mandate performance contracting for state owned facilities.

Summary of Costs and Benefits

The advantage of performance contracting is that it provides project financing as a component of the overall project scope. Many variations of performance contracting carry either a guarantee for savings or a shared savings approach to the project. Obviously, the cost of each project varies with the facility, but the return on investment can be calibrated to fit individual circumstances. Performance contracting also offers state facilities a complete package of energy efficiency opportunities. More expensive efficiency measures can be blended with those of shorter term payback to make the overall project financially attractive.

Regional Coordination/Interaction with Other Policies

The programmatic approach to performance contracting can be highly variable depending on how fast and successfully energy savings can be achieved. Much has been learned in the past decade about issues ranging from requests for proposals, to development of energy use baselines, to

measurement and verification of savings. Programs which blend the advantages of streamlined RFP processes with elements learned from "standard offer" approaches can be utilized to both speed the delivery of savings and help insure that projects are both of high quality and free from contention.

Required Action

Political leadership in Western states can encourage or mandate that state facilities utilize performance contracting as an approach for gaining energy efficiency. Progressive models for effective RFP processes and streamlined measurement and verification protocols should be developed by those who have knowledge of best practices in this regard. States should adopt these models to guide their performance contracting efforts. Furthermore, targets should be set by each state for state facility managers to conduct a review of performance contracting opportunities and a second date for follow through with energy service providers where project opportunities are deemed to have merit. Political leaders should develop an accountability system that insures that state facility managers are held to these target dates.

Energy Efficiency Best Practice
O & M Training for State Building Staff Program

Description

A substantial cost of the operation of state government is the maintenance of buildings. For a variety of reasons state government buildings are rarely maintained in optimal condition. Reasons include: lack of consistent funding for building upkeep and improvement; old or outdated HVAC equipment; energy management systems (EMS) that have been modified, over-ridden or disabled; and lack of trained personnel to operate buildings. An inexpensive method to improve the performance of state-owned buildings is to invest in operation and maintenance (O & M) training for facility management personnel.

Training for personnel could range from general courses on proper O & M, to expansive courses teaching personnel how to retro-commission a building. The more extensive the training, the more savings may be achievable. To restore a building to its most efficient operation, retro-commissioning is recommended. This comprehensive process involves evaluating and changing the entire building's operational system to optimize energy and system performance. If given extensive training, state facility personnel could perform this activity however, since retro-commissioning is complex, it may be beneficial to hire a contractor to provide these services. After a contractor completes retro-commissioning a building the building staff can be trained by the contractor or through a training course to maintain the savings from retro-commissioning. The goal of the program is to ensure that building maintenance personnel have the skills needed to restore a building to optimal operation and/or have the know-how to maintain improved conditions after retro-commissioning.

Public Policy Rational & Consistency with Deregulated Electricity Market

All citizens benefit when government operates more efficiently. Proper training of facility management personnel in state government can reduce costs by improving the operation and maintenance of state facilities. Proper O & M can also extend equipment life. A reduction in energy use will have a corresponding positive effect on the environment. Offering training to employees may also assist in employee retention.

Examples of Implementation

The Federal Energy Management Program (FEMP) offers a wide variety of training to facility managers. Through training and implementation of energy efficiency measures, FEMP estimates that for every $1 invested they leverage $4 in net savings.

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) offers a wide variety of training programs nationwide. They have chapters in every state that can provide training. Training can also be obtained from the national organization. If an organization has 15 or more people, on-site training can be coordinated that is specifically tailored to the needs of attendees.

The Building Owners and Management Association, Association of Facility Engineers, the Northwest Energy Efficiency Council, and ASHRAE all offer training on commissioning. The Building Commissioning Association and Association of State Energy Research and Technology Transfer Institutions both have developed one-day training O & M training.

Political Feasibility

The main obstacle to implementing a training program for facility management personnel is the initial cost. Many states have limited budgets for training and maintenance programs. Time away from work to attend training can also be an issue if there is not sufficient personnel to cover employees at training. States that want to lead by example, will find benefit in training personnel to achieve greater building performance. Comfort and worker productivity can also be improved for occupants of buildings by improving building operation.

Summary of Costs and Benefits

Depending on the level of training desired, costs can run from several hundred dollars for a one to two day training course to several thousand dollars for week-long or on-going courses. Operational savings from retrocommission and performing enhanced O & M can range from 5 to 15 percent of the energy costs for the building. Typically, building operational enhancement will payback in less than a year according to Portland Energy Conservation, Inc.

Regional Coordination/Interaction with Other Policies

This simple program could be easily implemented by each state. The cost would be low and there would be little need to coordinate with other regions. A multitude of training programs is available so states have a variety of choices to meet their needs. This program would operate the same in a deregulated or regulated electricity market.

Required Action

Education of facility managers is necessary to familiarize these decision-makers with the benefits of having trained on-site personnel. Individuals who control training budgets should be targeted, since cost is the major consideration for instituting a training program for state facility maintenance personnel. An assessment of current personnel should be conducted to determine the most appropriate training courses and level of expertise.

Energy Efficiency Best Practice
Use of Life Cycle Cost Analysis in State Procurement

Description

When constructing or renovating state government buildings, equipment and design elements are usually chosen based on the initial cost. Energy efficient equipment and systems typically have higher initial costs than less efficient equipment, but provides long term savings if the total costs of purchasing, operating, and maintaining the equipment is considered. Life cycle cost (LCC) analysis or life cycle costing is an economic evaluation is used to determine the relative cost effectiveness of an alternative building or building related systems or components.

LCC in Design can analyze all building types (proposed or existing), sources of energy (electricity, gas, oil, etc.), and other cost issues (maintenance and repair, disposal, equipment replacement). There are a variety of software products available to conduct LCC analysis. Results of the life cycle analysis can illustrate least overall cost options as well as show ranking of various options at the building cost level. Available software programs can calculate the net savings, savings-to-investment ratio, adjusted internal rate of return, and years to payback.

To increase the energy efficiency of state owned and operated buildings, states should institute the use of LCC procedures. To accomplish this goal, agencies should be educated and directed to conduct analysis for appropriate products and designs for new or renovation of public buildings.

Public Policy Rational & Consistency with Deregulated Electricity Market

Government buildings that are constructed or renovated using a LCC procedure will cost less in the long run. Since LCC analysis determines the cost-effectiveness of various components or designs, use of this tool provides the assurance that the design or equipment considered will provide a positive payback. This analysis can be critical to obtaining the funds necessary to afford the initial additional cost of energy efficiency equipment or systems.

Examples of Implementation

In addition to the ASHRAE 90.1 standard, the State of Arizona requires that LCC analysis be used when choosing new or replacing existing equipment. When the state prepares a bid for energy-related equipment, they perform a LCC analysis to develop the specifications for the equipment. The energy efficient equipment winning the bid is put on state contract. State contract can be utilized by any municipality or other political subdivision in the state so a greater number of entities ultimately purchase energy efficient equipment.

The state of Iowa has required the use of LCC in the design phase since 1980. The requirement is for all renovation and construction projects using public funds. Engineers and architects are required to perform LCC analyses that are then approved by the Departments of Natural Resources and Public Safety and the building owner. LCC analysis is used to guide design decisions and must be accepted before the building is put out to bid.

The Federal Energy Management Program uses LCC for federal buildings. DOE, in partnership with the Institute of Standards and Technology (NIST), has created and updates LCC software that they make available to anyone. Section 401 of Executive Order 13123 requires that "Agencies shall use life-cycle cost analysis in making decisions about investments in products…"

The State of Oregon requires that "facilities to be constructed or purchased by authorized state agencies be designed, constructed, or renovated in a manner that will minimize the consumption

of energy in their operation and maintenance." Construction and renovations are authorized if the building design incorporates all reasonable cost-effective energy conservation measures.

Political Feasibility

Using a LCC program can provide the entity constructing a new building or replacing equipment in an existing building with the justification to include energy efficient equipment, which typically has a higher first cost. A LCC procurement process ensures that the energy-related cost of a building will be less and that taxpayer funds are used most efficiently. Use of LCC when constructing a building can also provide information on what the building will cost to operate and maintain. Procurement personnel may be reticent to incorporate life cycle costing because they are not familiar with this type of accounting. Politicians and those responsible for funding construction must be educated to understand the long-term benefits of LCC.

Summary of Costs and Benefits

LCC analysis includes all the inputs to determine if an energy efficient building or piece of equipment will cost the same, more, or save money over the life of the equipment. Because software allows options to be ranked, equipment can be chosen that best fit financial resources.

Savings for using LCC vary dramatically. In a recent analysis on a chiller to be installed in a state hospital in Arizona, it was found that an energy efficient chiller had an additional first cost of $60,000, but the lifetime savings were determined to be $250,000.

In Iowa, LCC analysis must consider domestic hot water system alternatives, lighting system alternatives, and combined building envelope-HVAC systems alternatives. Fiscal year, non-cumulative saving estimates for pre-design projects have been: 1995 - $1,444,963; 1996 - $1,117,861; 1997 - $724,163; 1998 - $1,525,322; 1999 - $1,018,524; and 2000 - $480,369.

Regional Coordination/Interaction with Other Policies

Many states have energy codes that provide a prescriptive set of measures to be included in a building. LCC can enhance codes, because they provide specific information on various pieces of equipment. Equipment chosen through LCC can provide added savings over equipment specified in some codes.

Adoption of a LCC requirement for public buildings will not conflict with a deregulated electricity environment. Use of LCC should reduce the total cost of government buildings – benefiting the entire state.

Required Action

Depending on the state's structure, a LCC requirement could be created by the state legislature, the Governor by Executive Order, or by the procurement agency as policy. A law, executive order or policy can direct that LCC is used in the design of new buildings and/or for all new and replacement equipment. If LCC is to be performed by state personnel they must be trained on the use of LCC software tools. States can also require that design firms conduct the analysis for the state. The Department of Energy has software and training materials that are available free of charge. Performing this analysis will take some additional time and should be added to the steps involved in the procurement, bid or design processes.

Energy Efficiency Best Practice
Variable Speed Drives For Wastewater Treatment System Aeration

Description

Municipal and industrial wastewater treatment processes often incorporate biological treatment in the form of aerobic digestion. In this type of treatment, bio-organisms convert organic wastes to an inert form (sludge) in large aeration tanks with extended residence times. The digestion of the organic waste requires oxygen, and motors and blowers are used to mechanically introduce air into the tanks. Wastewater treatment system aeration processes are often controlled manually, and therefore are not energy-efficient. When the amount of air introduced into the vessel is controlled manually, samples of the waste in the vessel are tested for oxygen content, and motors and blowers are turned on and off, or sequenced, as needed. This often results in either too much or too little air being introduced – with wasted energy and poor quality waste treatment often resulting. The use of automatically controlled aeration systems, by employing variable speed drives and oxygen sensors to reduce electricity consumption and demand, can result in significant energy savings and provide more effective levels of wastewater treatment. Blower speed can be continuously controlled based on the need for oxygen in the digestion process. In many cases, it is possible to achieve a de facto increase in aerobic digestion system capacity by exercising better control.

Public Policy Rational

Approximately 60 percent of all the electricity used in a wastewater treatment system is for aeration. Installation of variable speed drives can reduce operating costs for a plant and greatly improve the system itself by providing the optimal level of oxygen for aerobic digestion. Wastewater treatment plants have not been a focus for energy conservation efforts but hold tremendous potential for saving. For many small municipalities the wastewater treatment operations are the largest consumer of electricity, thus they should be one of the first targets for energy efficiency.

Examples of Implementation

The Department of Energy Motor Master Plus program has coordinated educational seminars to inform water and wastewater personnel about energy savings opportunities. In Arizona four day-long seminars were held on motors and pump improvements.

According to the California Energy Commission, variable speed drives can cost about $3,000 for a 5 horsepower motor to about $45,000 for a custom built, 300 horsepower motor. Larger variable speed drives can cost more. The playback period for these drives is a few months to less than three years for 25 to 250 horsepower models. There is also savings in reduced maintenance and longer lasting equipment

San Diego Gas and Electric provided incentives to the Moulton Niguel Water District to install variable frequency drives on their pump in their wastewater treatment operation. The savings for the drives were 4% of their total energy consumption and $3,000 per year.

Political Feasibility

This program is politically feasible if there is an entity in each state identified to spearhead this educational effort. A state-level energy or council of governments could be engaged to lead this initiative. This program would make municipality more efficient so it should be well received.

Summary of Costs and Benefits

According to the California Energy Commission, variable speed drives can cost about $3,000 for a 5 horsepower motor to about $45,000 for a custom built, 300 horsepower motor. Larger variable speed drives can cost more. The playback period for these drives is a few months to less than three years for 25 to 250 horsepower models. There is also savings in reduced maintenance and longer lasting equipment

Regional Coordination/Interaction with other Policies

If incentives are provided this program would dovetail with existing utility rebate programs. The promotion of energy efficiency in wastewater treatment is consistent with the mission of many state energy offices. This program can work with the Department of Energy Motor Master Plus program to provide technical assistance.

Required Action

To promote the use of variable speed drives on wastewater treatment system aeration motors to reduce peak electric demand and reduce electricity consumption; the following initiative elements are required:

- Identification of targets: this involves the analysis of existing state municipal wastewater treatment facilities to determine the number of target facilities for the initiative. Additional analysis would be required to determine the same type of information for privately owned and operated industrial wastewater treatment facilities.
- Training: training is required on two levels. The first is to provide training to contractors and other initiative implementation stakeholders on the identification and analysis of these types of opportunities. The second type of training is targeted at the prospective users of the technology, in the form of a series of workshops to explain the technology and its benefits, and to generate interest in its implementation.
- Outreach: this involves preparation of outreach materials (brochures, technical briefs) to accompany and complement the industrial workshops, and also target industrials not attending the workshops. It is expected that outreach efforts could be undertaken jointly with other agencies and/or with industry associations or chambers of commerce in the state.
- Demonstration and evaluation: states may wish to choose one or more prospective sites to demonstrate the application of this technology/strategy. A formal demonstration project can be established, with results widely distributed to other targeted industrials.

The targets for this initiative are the wastewater treatment facilities within the POTW (publicly owned treatment works) sector, and manufacturing plants that operate their own wastewater treatment or pretreatment facilities. A wide range of industrials could participate in this initiative. A major manufacturing sector target could be the dairy and food processing industry, which often employs pretreatment of wastewater to reduce BOD (biological oxygen demand) before discharge to municipal treatment works.

Energy Efficiency Best Practice
Provision of Spinning Reserve from Pumping System Load

Description

Spinning reserve is a type of reserve generation. It is provided to ensure the reliability of the grid. This service has traditionally been provided by generating capacity that is synchronized to the grid, that begins to respond or ramp up immediately, that is fully available within ten minutes, and that responds to frequency deviations or a signal to supply. It is used to correct for generation/load imbalances caused by generation or transmission outages. Ten minutes is a maximum time for the generation ramp up to be completed. The reserve generation is typically provided for two hours or less.

Spinning reserve is a relatively high priced service compared to the other types of reserve generation, which are not required to be available as quickly. The Oak Ridge National Laboratory (ORNL) has conducted some initial research and believes that spinning reserve may be able to be provided by reducing electrical load instead of increasing generation. This would "free up" generation to generate, instead of operating in an idling condition. The load has to be flexible, however, and willing to permit this to happen. In cases where load has "built in" short term storage capacity and can be automatically controlled, this service may be provided by loads. There is a very real possibility in the water pumping industry.

Public Policy Rational

To meet the growing demand for power in the West, a substantial number of new power plants will be required. To maintain grid stability it is necessary to require that generators have spinning reserves that are on call. If entities besides generators are allowed to maintain spinning reserves, then generators will be able to sell into the market place the power they formally were required to hold in reserve. This will be beneficial for the generators and can provided an additional source of needed power without building additional generation.

Examples of Implementation

Water pumping systems usually use tanks, reservoirs, aqueducts, etc., which have a natural short-term energy storage capacity. With the appropriate engineering, modifications, and operations changes, ORNL believes that many water pumping systems could be used to provide spinning reserve. California, especially, has huge opportunities.

Spinning reserve is different from peak shaving or load management. It has never been done before, because a rule change is required. Present NERC and WSCC rules require spinning reserve to be supplied only from generation. ORNL had discussions with NERC regarding this rule and they have indicated that the time may be right for a rule revision. Hence, NERC has requested that a waiver be submitted to initiate a rule change.

In the California Department of Water system, the total electrical load is about 2.2 GW. Pump motors are controlled in 100 MW blocks and much of the load is near Path 15, the most congested transmission corridor in the WSCC. ORNL has not yet investigated the exact locations of the load, but load on the north side of the path would be best.

Because the motors must be equipped with variable frequency drives to enable them to "run back", the major portion of the cost is in the drives. The existing SCADA system will probably not need to be expanded only reprogrammed.

Political Feasibility

Creating a program to use spinning reserves may help alleviate short-term electricity supply problems. This program may be politically charged, because it requires charges to NERC and WSCC rules. Support for this change could come from generators, in that it allows them to sell generation currently required to be held in reserve. However, opponents to this change may be those entities responsible for the stability of the grid and regulators. If a rule change is adopted, this program could be implemented quickly. However, working through the FERC and WSCC rules process to get the rule change make take considerable time and effort.

A sensitivity in a rule change such as this is if the change is being contemplated just to help power-starved California. State regulators throughout the west would need to evaluate if this change would be advantageous to their state.

Summary of Costs and Benefits

Savings would be two fold: in "freeing up" generation to generate and in alleviating congestion. In California, Path 15 is presently causing stage 3 emergencies and untold millions of dollars of damage to the California economy. ORNL estimates that 500 MW of generation could be "freed up" if it is assumed that pumping load can provide spinning reserve at a cost of $20 per MW hour less than generation, and it provides this service 24 hours a day. This translates to a savings of 500x20x24x365 = $88 million per year. The elimination of the emergencies and black outs would probably be a much greater benefit. ORNL estimates that the cost of the modifications near Path 15 would be approximately $50 million.

Regional Coordination/Interaction with Other Policies

Allowing spinning reserves to be produced by non-generators is a regional issue that will affect the entire West. A policy change such as this would need to be evaluated by the WSCC to determine the potential effect on transmission line stability and impact on having a reliable source of spinning reserve.

Required Action

If the change were made to allow non-generators to provide spinning reserve, then each state would need to evaluate its potential capacity of providers. If sufficient capacity were determined to be available then states or other entities would need to:

?? develop operations protocols to ensure that two hours of storage is available in the pumping,
?? design and install the controls and communications on pumping systems, and
?? design and install the variable frequency drives for the pump motors.

It may be possible that simply cycling off pumping systems could provide spinning reserve. If so, this would reduce the cost and greatly accelerate deployment.