CHALLENGE TO TOP MANAGEMENT

Energy Efficiency

Self-Assessment Guide For Energy Saving Opportunities

A Team Approach to Improve Financial Performance, Pursue Cleaner Air, & Reduce Dependency on Foreign Energy

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State Energy Office

ENERGY

"Ensuring a sustainable energy future"

N.C. Department of Administration

HOW TO USE THIS GUIDE

The purpose of this guide is to encourage leaders to engage their organizations in striving for more efficient use of energy resources, thereby improving financial performance, pursuing cleaner air and reducing dependency on foreign energy. Upgrading organizational performance increases productivity and improves safety. Additional benefits are improved work environment and enhanced service to customers.

Each individual plays a part in achieving energy efficiency goals at your business, industry, government or institutional facility. The critical factors are leadership and individual behavior based on awareness of expectations.

This Energy Self–Assessment Guide poses questions that can establish priorities and identify measures to be taken.

Table of Contents

YOU HAVE THE POWER!

ENERGY USE

Where do you use the most energy? The following information can help you determine where your most rewarding energy efficiency opportunities are. Energy is a significant portion of your controllable and variable overhead expense and should be considered a critical financial performance factor!

ENERGY USAGE CATEGORIES (%)

TYPE OF OPERATION	HVAC	Lighting	Hot Water	Food Prep.	Misc. Use	Process/ Equipment
Office Building	40	29	9	2	5	15
Manufacturing	35	28	2	0	3	32
School/Education	50	20	22	3	3	2
Hotel/Motel	25	18	40	7	6	4
Apartment Bldg.	70	15	5	0	10	0
Retail Store	51	31	7	3	4	4
Restaurant	23	15	11	45	5	1
Health Care	30	16	26	7	14	7
Religious Inst.	41	46	9	2	1	1

Adapted from: Handbook of Energy Engineering, 4th edition, EIA, and NREL 2000.

How does your facility compare in energy consumed with other similar facilities? How much potential energy and cost savings are achievable?

The efficiency of energy use of a building can be benchmarked to establish an annual energy use reference for comparison with other buildings of similar size, functional use, and operating schedules. This benchmark, also termed a "key performance indicator" (KPI), can be used to track the savings generated by the application of Energy Conservation Measures on a monthly basis.

Many organizations review their energy benchmarks on a dollars per square foot basis ($/sf). With increasing utility rates, tracking the energy use performance in units such as 1000 Btu (KBtu)/sf is more useful than tracking energy expenditure dollars. For some organizations, benchmarks can be more accurately tracked as Btu per product produced or per customer served.

ANNUAL ENERGY BENCHMARKS
Southeast

	Average Energy Cost $/sf	Average Energy Use Kbtu/sf
K-12 schools	$1.22	68.3
Colleges	$1.25	93.4
Hospitals	$2.96	246.8
Public Assembly	$1.20	68.9
Restaurants	$5.52	308
Large Office	$1.64	86.4
Small Office	$1.73	93.4
Warehouse	$0.59	34.5
Lodging	$1.84	101.1
Retail	$1.67	90.7
Health Care	$2.24	118.6

Source: Adapted, Tech Resources, September 2008

ADMINISTRATION & COMMUNICATIONS

- ☐ **Has the critical need to be more efficient in the use of energy at your location been incorporated into a Strategic Energy Plan and broadly communicated?**
- ☐ **Is there a staff position that includes responsibility for utilities management?**
- ☐ **Have energy teams or Conservation Action Teams (CAT) been organized to provide leadership and enhance the success of the behavioral aspects of reducing energy?**
- ☐ **Is there a program to recognize individuals who provide leadership and increase the success of the Energy Plan?**
- ☐ **Are Energy Conservation posters conspicuously displayed throughout your facility?**
- ☐ If energy systems have not been recently upgraded, have you considered using an energy expert to conduct an efficiency assessment?
- ☐ Does your capital investment policy include criteria for financing energy upgrade projects?
- ☐ Are you aware of recent utility incentives (and tax incentives) for energy efficiency and renewable energy projects?

Note: All questions in bold print represent initiatives that can generate 50% or more of your energy savings at minimum cost.

Energy Savings Example

- Electric rate reviews resulting in correcting charged rates are saving North Carolina state agencies in excess of $4.7 million since 2002.
- Demand (kW) charges typically account for 25–35% of the total electric bill and can be reduced.

- ☐ **Is energy usage and cost data tracked monthly and distributed to all major users?**
- ☐ Is data monitored to question and pursue remedies for unusual variations from the norm?
- ☐ Are benchmarking or Key Performance Indicators used to determine performance goals?
- ☐ Are facilities with high costs surveyed to discover opportunities for cost reduction?
- ☐ **Are energy costs and program performance included in monthly business reviews?**
- ☐ Are measures taken to discover billing errors and recover incorrect charges?
- ☐ Do you understand your electrical rate structures?
- ☐ Do you know your electricity costs associated with both use (kWh) and demand (kW)?
- ☐ On an annual basis, do you review rates with your supplier to ensure you are on the most favorable rate structure?
- ☐ When you change the use of your facility, do you also review the impact on your rates?

OFFICE EQUIPMENT

Energy Savings Example

- Using Energy Star Office Equipment saves about $60 per employee per year.

☐ Are computers, monitors, printers, copiers, and other office equipment turned off and/or set for "sleep" mode when not in use?

☐ Is Energy Star equipment specified for new purchases?

NEW CONSTRUCTION

☐ If you are expanding or constructing a new building, are you giving full consideration to a LEED certified or a "High Performance" designed and constructed facility, that addresses building orientation, design, layout, lighting, equipment and control selections that will result in maximum energy efficiency?

VEHICLE USE & SELECTION

☐ Are employees given incentives for car pooling or using mass transit?

☐ When your organization purchases vehicles, are fuel mileage and emission levels considered?

☐ Have you investigated using alternative fuel vehicles (AFV), hybrids or considered cooperating with community AFV efforts?

Energy Savings Example

- Each 5000 watts of office lighting turned off for 20 hours per week will save $443 per year.
- The elimination of 25 75–watt bulbs will save $479 per year.

☐ **Are lights turned off when rooms or areas are not occupied?**

☐ Are lighting systems wired so that lights throughout a large area do not have to be on when activity is taking place in only a small section of the area?

☐ Is task lighting used to allow background lighting to be reduced?

☐ Have energy conservation stickers been placed on light switches?

☐ Has High-Bay T-5 Fluorescent Lighting been evaluated for high ceiling areas?

☐ Are occupancy sensor controls considered which can automatically turn off unused lights in meeting rooms, offices, etc.?

☐ Have incandescent lamps been replaced with compact fluorescent lamps?

☐ Have T–12 34–W fluorescent lamps and old ballasts been replaced with T–8 lamps and electronicballasts?

☐ **Are low wattage lamps used in existing fluorescent lighting fixtures?**

☐ **Have measures been taken to remove unnecessary lights or de–lamp fixtures in overlit areas?**

- ☐ Are old ballasts upgraded when lamps are replaced?
- ☐ Are Light Emitting Diode (LED) lighting fixtures used in EXIT signs?
- ☐ **Has unnecessary lighting in snack and beverage machines been removed?**
- ☐ **Have housekeeping and security staff been advised to keep lights turned off in unoccupied spaces?**
- ☐ Is it possible to schedule some or all housekeeping duties during daylight or operating hours?
- ☐ Are exterior light photo cells/controls working properly?
- ☐ Has the use of decorative or unneeded exterior lighting been discontinued?
- ☐ Are lights controlled by an Energy Management System?

SPACE CONDITIONING - HVAC

Energy Savings Example

- Typical energy savings generated by a regular tune–up of HVAC systems is 10%.

- ☐ **Do you have a service contract agreement to provide for regular safety and efficiency maintenance to the systems?**
- ☐ When replacing an inoperative system or component, do you use the opportunity to upgrade efficiency as opposed to installing an exact replacement?

- ☐ **Are energy efficient heating and air conditioning thermostat set points maintained throughout your facility (70°F heating, 76°F cooling)?**
- ☐ Are thermostats regularly calibrated?
- ☐ Are thermostats tamper–proof?
- ☐ Are thermostats properly located to provide balanced space conditioning?
- ☐ Are safety rules enforced to prohibit the use of personal heating and cooling devices?
- ☐ Are air conditioning or heating controls setback when weather conditions permit?
- ☐ **Are air conditioning or heating controls set back when facility is not occupied?**
- ☐ **Have programmable thermostats been considered for automatically controlling set points when spaces are as well as not occupied?**
- ☐ Are off–hour meetings scheduled in locations that do not require HVAC in the entire facility?
- ☐ Is housekeeping scheduled to minimize the use of space conditioning?
- ☐ Are air filters inspected on a regular basis and cleaned or replaced when necessary?
- ☐ Are surfaces on cooling coils, heat exchangers and condensing units regularly cleaned?
- ☐ Are exhaust fans turned off along with the HVAC systems when a space is unoccupied?

- ☐ Has supply air from air–handling units been adjusted to match the volume of space conditioning requirements?
- ☐ Has direct conditioning of unoccupied areas (corridors, stairwells, storage rooms, etc.) been minimized by turning off fan coil units and unit heaters, and by closing supply air diffusers?
- ☐ Are outside air dampers controlled to close when conditioned space is unoccupied?
- ☐ If economizers are present in your HVAC systems, are they modulated to take advantage of free cooling when outside temperature is below 65°F?
- ☐ If you use cooling towers, have water meters been installed to record makeup water usage (losses due to blow–down, evaporation and drift) that should result in sewer charge credits?

Energy Savings Example

■ Chillers consume more than 50% of electrical energy during seasonal periods of building use. More than 120,000 chillers in the U.S. are expending more than 30% additional energy through operational inefficiencies (Source: USDOE 2008)

- ☐ Are loading, operating conditions and maintenance service records evaluated periodically by a technician or service representative to ensure that chillers are operating at optimum efficiency?
- ☐ If water cooled, is cooling tower water temperatures output sufficient to optimize chiller efficiency? A poorly maintained water tower can reduce chiller efficiency by 10-35%.
- ☐ Is the inside of condenser and evaporator coils chemically cleaned periodically to optimize chiller efficiency? Poorly maintained heat transfer surfaces can reduce efficiency 5-10%.

BUILDING ENVELOPE

- ☐ Is weather stripping on windows and doors well–maintained?
- ☐ Are blinds and shades adjusted to take advantage of daylight and to utilize or avoid the impact of solar heating?
- ☐ Have thermal windows been installed to minimize heat and cooling losses?
- ☐ Are operable windows opened for ventilation during mild weather conditions?
- ☐ Are window air conditioners covered during the heating season?
- ☐ Can the insulation of a building be improved, particularly in the roof area?
- ☐ Are light-colored, reflective roofing materials specified?
- ☐ Have you considered flexible windbreaks and interior doors for loading area.

ELECTRIC MOTORS

Energy Savings Example

- When purchasing a new motor, the additional cost of a “premium” efficiency motor will be paid back in less than 2 years.

- ☐ Do you have a motor management policy that mandates “premium” efficiency motors?
- ☐ Do you require repair shops to maintain the efficiency of large motors when they are rewound?
- ☐ Is idling of motor-driven equipment avoided when no foreseeable use is scheduled?
- ☐ Are motor air vent ports clean and areas adjacent to motors uncluttered and well ventilated?

- ☐ Are heavy–duty replacement bearings used when conducting maintenance?
- ☐ Are cogged belts used in belt–driven applications or when replacing worn V–belts?
- ☐ Are electric motors selected appropriately to avoid power inefficiency and over–capacity?

STEAM & HOT WATER SYSTEMS

Energy Savings Example

- A steam leak of 1/16" diameter at 100 PSIG represents $2,082 per year of wasted energy.

- ☐ Are boilers and burner units inspected and maintained by a qualified technician on a regular basis to achieve maximum efficiency and safety?
- ☐ Is the most cost–effective fuel used?
- ☐ Are steam traps inspected and maintained on a regular basis?
- ☐ Is there a leak repair program maintained to deal with steam and condensate lines and valves?
- ☐ Are steam lines, hot water storage tanks, heat exchangers and piping well–insulated?
- ☐ Is hot water temperature set at the minimum required?
- ☐ Are low flow showerheads, faucet aerators, and flow restrictors used?
- ☐ Are low flow pre-rinse sprayers used in kitchens?
- ☐ Are timers installed on water heaters to avoid energy consumption when there is no demand on the system?
- ☐ Are timers installed to deactivate circulation pumps during times of no demand on the system?
- ☐ Have tankless water heaters been considered to reduce line losses in remote locations?

RENEWABLE ENERGY

- ☐ Have you considered solar thermal applications for large hot water uses (e.g., process water, swimming pools, kitchens, etc.)?
- ☐ Do you generate waste by-products, such as wood biomass, that could be used to generate heat, methane, or even electricity?
- ☐ Is your organization interested in reducing its carbon footprint or "green" marketing by employing renewable technologies such as geothermal, solar photovoltaic, or wind?
- ☐ Are you aware of recent utility incentives and state and federal tax incentives for renewables and energy efficiency technologies?

COMPRESSED AIR

Energy Savings Example

- A 1/16" diameter compressed air leak at 100 PSIG wastes $821 per year.
- A 60–HP air compressor operated at 95 PSI instead of 110 PSI can save $420 per year.

- ☐ Is a regular inspection for leaks conducted on compressed air lines?
- ☐ Are systems turned off whenever possible?
- ☐ Are system–wide pressure settings maintained at lowest possible operating levels?
- ☐ Are air intake ducts designed to supply cooler outside air to compressor?
- ☐ Is heat from compressor cooling systems deflected to avoid intake on adjacent equipment?

MISCELLANEOUS EQUIPMENT

- ☐ **Is miscellaneous equipment turned off wherever possible?**

☐ Are refrigeration units in drinking fountains turned off or set to no lower than 60ºF?

☐ Have non–essential refrigerated vending machines and refrigeration/ice machines been taken out of use?

☐ Have electrically–heated defrost cycles on refrigerated walk–in boxes been minimized and scheduled for off–peak energy consumption hours (night)?

☐ **Are automatic controls adjusted (temperature, speed, other settings) to minimize energy use but accomplish the task?**

ENERGY MANAGEMENT SYSTEMS (EMS)

☐ Have you considered using or upgrading an energy management system (EMS)?

☐ Is your EMS used to limit peak electrical demand on key equipment to avoid high demand charges and penalties?

Energy Management Systems

EMS automatically monitor and control HVAC, lighting, and equipment to conserve energy, maintain function, and provide occupant comfort. EMS can accomplish the following and more:

- Control lighting systems by the hour and dim for decreased demand during daylight hours
- Optimize HVAC operations based on environmental conditions and changing uses
- Turn off or set back HVAC during non-working hours
- Deactivate water heaters when possible
- Activate and monitor security systems
- Control peak loads to reduce demand charges

BEST ENERGY MANAGEMENT PRACTICES

1. Commitment by top–level management.
2. Clearly defined energy–reduction goals.
3. Communication of the goals to all organizational levels.
4. Assignment of responsibility and accountability at the proper level.
5. Tracking of energy use.
6. Continuous identification of all potential savings.
7. Adoption of project investment criteria reflecting project risks and returns.
8. Provision for recognition and reward for achieving the goals.

NEXT STEPS: ACTION ITEMS FOR TOP MANAGEMENT

- Brief your organization on energy efficiency responsibilities and the economic and environmental justifications.
- Establish Conservation Action Teams (CAT) with guidelines to:
    - Develop a Strategic Energy Plan
    - Create an Action Plan
    - Train and Motivate Staff
    - Evaluate Performance
- Set Energy–Saving Goals.
- Communicate management goals and report progress.
- Obtain external assistance, if appropriate.

RESOURCES

"How to Reduce Your Energy Costs" Fourth Edition, Advantage Publications and Insights.

EPA – Energy Star
www.energystar.gov

U.S. Department of Energy – Energy Efficiency & Renewables
www.eere.energy.gov

State Energy Office, N.C. Department of Administration

N.C. Project Green
www.ncprojectgreen.com

N.C. Division of Pollution Prevention & Environmental Assistance
www.p2pays.org

The Motor Resource Center
www.motorresourcecenter.net

Waste Reduction Partners
www.landofsky.org/wrp

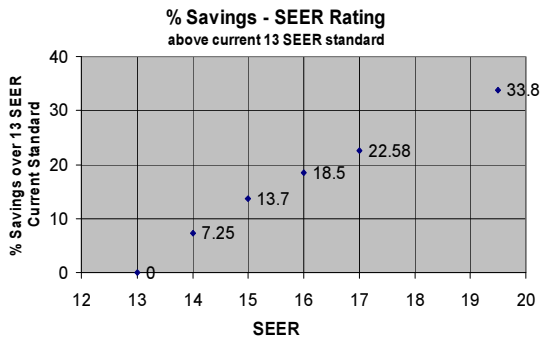
Incentives for Renewables and Efficiency
www.dsireusa.org

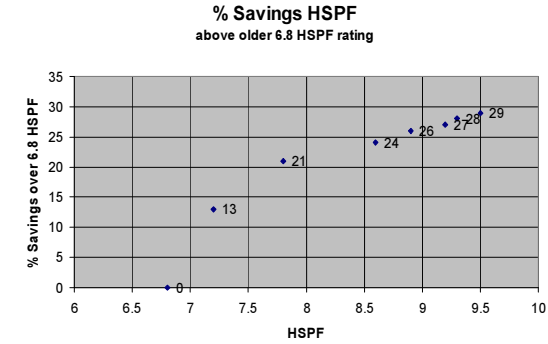
UNDERSTANDING EFFICIENCY RATINGS

SEER - The Seasonal Energy Efficiency Ratio is a measure of the cooling efficiency of your air conditioner or heat pump. The higher the SEER number, the more efficient the system is at converting electricity into cooling power. A 13 SEER minimum applies to all new equipment manufactured after January, 2006.

HSPF - The Heating Seasonal Performance Factor is a measure of the heating efficiency of a heat pump. The higher the HSPF number, the more efficiently the heat pump heats your home.

AFUE - Annual Fuel Utilization Efficiency. Indicated as a percentage, your furnace's AFUE tells you how much energy is being converted to heat. For example, an AFUE of 90 means that 90% of the fuel is being used to warm your home, while the other 10% escapes as exhaust with the combustion gases.





ENERGY PERFORMANCE CONTRACTING

Performance Contracting is a method of financing capital projects in buildings for upgrading equipment and systems that are not energy-efficient. These Energy Savings Performance Contracts are a single procurement contract for the engineering, construction, installation, start-up, operational measurement and verification for energy performance improvements that will result in avoided energy costs. In a Guaranteed Energy Saving Contract, the selected contractor (termed Energy Saving Company, ESCO) will guarantee a minimum level of energy utility cost savings to the customer resulting from project upgrades. These guaranteed savings support the debt obligation of the customer to finance the project for terms typically 12 to 20 years. National studies show the average energy saving achieved through performance contracting is 20 percent.

8 Steps to Energy Saving Performance Contracting:

1. Assess the Need
2. Define the Project
3. Issue Request for Proposals
4. Evaluate Proposals and Select ESCO
5. Perform Technical Audit
6. Negotiate Final Contract and Secure Financing
7. Project Construction and Implementation
8. Commissioning, Training, Measurement and Verification

ENVIRONMENTAL SAVINGS

NC Power Plant Emission Reductions

Conserving 1,000 kWh will:

- Reduce 1190 lbs. CO_2 (greenhouse gas)
- Reduce 2.93 lbs. of nitrous oxides (precursor to ozone)
- Reduce 7.61 lbs. of sulfur oxides, SO_x (acid rain and visibility pollutant)

Passenger Car Emission Equivalents

4,500 kWh/year = carbon dioxide emissions from one vehicle

Forest Equivalents

3,310 kWh/yr = carbon dioxide removed by one acre of forest

CONVERSION FACTORS

Fuel Oil = 140,000 BTU / gallon

Coal = 14,000 BTU / pound

Natural Gas = 1,000 BTU / cubic foot

1 therm = 100,000 BTU

1 kilowatt (kW) = 1.341 horsepower (hp)

1 horsepower (hp) = 0.746 kilowatt (kW)

1 kilowatt – hour (kWh) = 3,412 BTU

1 ton of cooling capacity = 12,000 BTU / hour

COST OF PURSUING ENERGY EFFICIENCY

NO COST. Numerous improvements in efficiency can be achieved through more effective management of resources and informed employee behavior. See back page, TEN MOST WANTED—Simple ways to save 50% or more of your energy costs.

INCREMENTAL IMPLEMENTATION. Other efficiency initiatives can be supported with operating and maintenance budgets to be accomplished over an extended period of time. One example is the incremental upgrading of T–12 to T–8 fluorescent lamps and electronic ballasts during spot lamp replacement. Upgrade costs can be spread out over a two–year period and deliver a payback of less than 3.0 years.

CAPITAL APPROPRIATIONS. Some efficiency projects must be addressed with capital appropriations that require a payback analysis. Although almost every project is unique to a particular application, the initiatives in the following "Estimated Savings Potential" section (pages 22-23) are most likely to be worthy investments with attractive paybacks. When capital funding is not available, managers can also consider performance contractors to finance upgrades.

PAYBACKS. Payback may vary according to the scheduled use of a facility, types and configurations of energy consuming systems, climate and regulatory codes. **HOWEVER**, projects involving systems or facilities that are exposed to the most hours of daily use are likely to benefit from accelerated and shorter paybacks. More favorable paybacks can also be experienced if similar projects at several different sites can be combined to benefit from more competitive contract bidding.

Lighting	Payback (yrs)	Energy Reduction (%)
Using Energy Saving Fluorescent Lamps	1.8-2.4	15
Upgrading old T - 12 Fluorescent Lighting and ballast with T - 8 and electronic ballasts	2.7-5.0	30-35
Replacing incandescent lamps with Compact Fluorescents	0.5-3.2	66-75
Upgrading 400-watt Metal Halide Suspended fixtures	0.6-1.25	10-28
Replacing incandescent Exit signs with LED	<2.0	87
Replacing HID lighting with High Bay T5/T8 Fluorescents	2-4	37-57
Using Occupancy Sensors in:[1]		
Office	2.3-4.6	25-50
Restroom	1.0-2.6	30-75
Meeting room	0.5-1.3	22-65
HVAC		
Overall HVAC Saving potential[2]		30+
Cooling upgrade opportunities[3]		
Central Chiller	variable	15-35
Unitary A/C	variable	20-35
Heating upgrade opportunities[3]		
Boiler	variable	10-30
Furnace	variable	5-25
Periodic heating system maintenance[3]	<.25	5-10
Nighttime temperature setback[2]	<.5	10-33
Reducing heating temperature 3[1]	instant	12-13
Fan optimization, variable speed drive (60,000 cfm example)[2]	2.1	50-85
Building Envelope		
Reducing air infiltration in large office building heating and cooling	variable	1-5

	Payback (yrs)	Energy Reduction (%)
Motors		
Specifying "premium" efficiency motor vs. standard efficiency[4]	2.0 for typical 20-hp	3.3-6.9
Using cog-belts instead of V-belts[5]	<2.0	2-8.4
Air Compressor Systems		
Energy Savings[5,6]	variable	20-50
Redirect compressor air intake to use outside air[5]	<1.0	5-7
Lowering system-wide pressure by 10 psi[1,5]	instant	3-6
Repairing compressed air leaks[5]	0.1	5-25
Office Equipment		
Savings Using Energy Star Equipment[7]		
Dishwashers	1.4	25
Refrigerators	1.3	35
Copiers	instant	25
Computers	instant	30-70
Monitors (LCD)	instant	25-60
Water Use		
Replace pre-1995 toilets with new or HET	2.6-3.0	63 (water)
Use low flow showerheads and sink aerators	<0.3	35
Use low flow pre-rinse sprayers	0.1	50+
Energy Management Systems		
Typical Energy Use Savings using EMS's[2]	variable	10-20

Payback estimates are based on one-shift operations using an NC average commercial electric rate of $.0851/kWh. Internal labor usage is assumed. Most paybacks noted are typical for office settings. Payback periods can vary widely based on individual applications.

References:

[1] Federal Energy Management Program, "Occupancy Sensors", 26 Jun 2003, <http://www.energy.wsu.edu/cfdocs/tg/27.htm>.

[2] "How to Reduce Your Energy Cost: The Energy Efficiency Guide for Business, Industry, Government and Institution," Third Edition, 2001 Advantage Publications.

[3] EPA Energy Star Building Manual, October 2007.

[4] Motor Challenge Fact Sheet: Buying an Energy-Efficient Electric Motor.

[5] "A Self-Assessment Workbook for Small Manufacturers", Version 2.0, Rutgers University Office of Industrial Productivity and Energy Assessment.

[6] "Improving Compressed Air System Performance: A Sourcebook for Industry", USDOE, Motor Challenge Program, April 1998.

[7] EPA Energy Star, Sept. 2008, <http://www.energystar.gov>.

Simple ways to save 50% or more of your energy costs:[2]

1. Get entire organization involved!
2. Turn off lights when not needed.
3. Remove unneeded light bulbs.
4. When replacing bulbs, use lower wattage or more efficient ones.
5. Lower your thermostat heating settings; raise air conditioning settings.
6. Reduce heating and air conditioning during unoccupied hours.
7. Turn off heating and air conditioning somewhat before the end of your operating hours.
8. Have your heating, ventilation, and air conditioning systems serviced regularly.
9. Turn off machines and equipment when not needed.
10. Make sure all automatic controls are in good working condition and are set properly.

For more information, contact:

Waste Reduction Partners
Land-of-Sky Regional Council
339 New Leicester Hwy, Suite 140
Asheville, NC 28806
(828) 251-6622
www.landofsky.org/wrp

or

State Energy Office
1830–A Tillery Place
Raleigh, NC 27604
1–800–662–7131

Sponsored by the State Energy Office, N.C. Department of Administration and the U.S. Department of Energy, with State Energy Program funds, in cooperation with **Land–of–Sky Regional Council** (Waste Reduction Partners). However, any opinions, findings, conclusions, or recommendations expressed herein are those of the author(s) and do not necessarily reflect the views of either the N.C. Department of Administration or the U.S. Department of Energy.
5000 copies of this publication were printed at a cost $1,512 or $1.51 each.

October 2008 Revision. Printed on recycled paper.