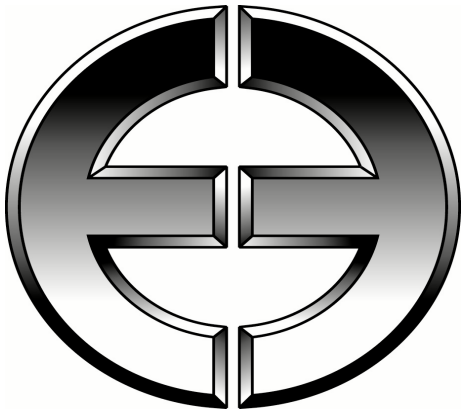
Engineering Extension
Kansas State University



Energy Efficiency
In and Around Your Home

David Carter
November 30, 2010

Mission of Engineering Extension

To effectively deliver relevant technical knowledge focused on energy and the environment

Engineering Extension Target Areas

- Energy and the Environment
  - Radon Program – 18+ Years
  - Indoor Air Quality
  - Biomass/Biofuels – Richard Nelson
- Pollution Prevention - Businesses

Energy Extension Service

Goals:

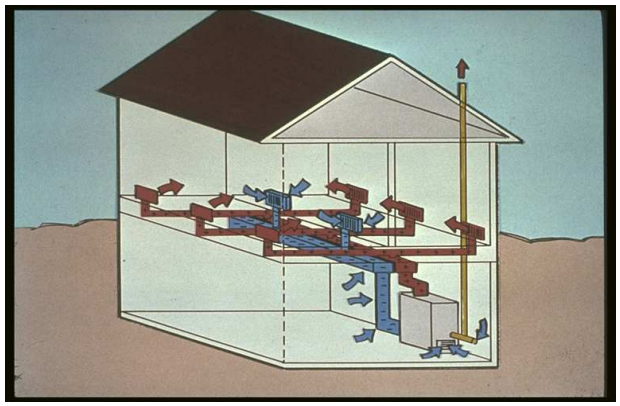
- Provide unbiased and accurate information to the Kansas energy consumer.
- Assist professionals to make informed decisions with regard to energy and environment.

K-STATE Kansas State University RESEARCH & EXTENSION

Energy Assistance

Current activities include:

- Fact sheets
- Telephone assistance
- Links Library
- Extension Agent Training



Questions Are Key

- Energy Extension Service (EES) provides answers to your energy concerns. Specialists are available to answer questions and provide advice on ways to reduce energy use in your home and small business.
- **Renewables**
- **Home Energy**
- **Building Energy Codes**
- **Climate Change**
- **Sustainability**
- **Ventilation and Moisture**

FAQ Samples

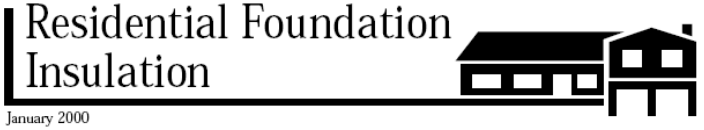
- What are the suggested R-values for the various components of a home?
- What are low-emissivity windows, and what are their advantages?
- Which is the better method for insulating basement walls: exterior or interior insulation?
- Will a programmable, setback thermostat save enough energy to pay for itself?
- Why is it important to properly size an air conditioner?
- What is a ground-source heat pump?

http://www.engext.ksu.edu/ees/henergy/publications.html

Publications

- **Home Energy**
- Cut Winter Costs
- Home Energy - Answers to Home Energy Questions
- Energy Efficient Appliances
- Home Energy Ratings
- **Building Thermal Envelope**
- Air Sealing
- Builder's Guide to Residential Foundation Insulation
- Energy-Efficient Windows
- Residential Foundation Insulation
- Residential Insulation
- Tips for Purchasing an Energy-Efficient New Home
- **Space Heating and Cooling**
- Comparing Fuel Costs of Heating and Cooling Systems
- Selecting a Home Cooling System
- Selecting a Home Heating System
- Solid-Fuel Heating Appliances

12 Simple, No-Cost or Low-Cost Tips to Reduce Heating Costs



Advice from Benjamin Franklin

- Beware of little expenses. A small leak will sink a great ship.
- A penny saved is a penny earned.
- Buy what thou hast no need of and ere long thou shalt sell thy necessities.
- Gain may be temporary and uncertain; but ever while you live, expense is constant and certain: and it is easier to build two chimneys than to keep one in fuel.

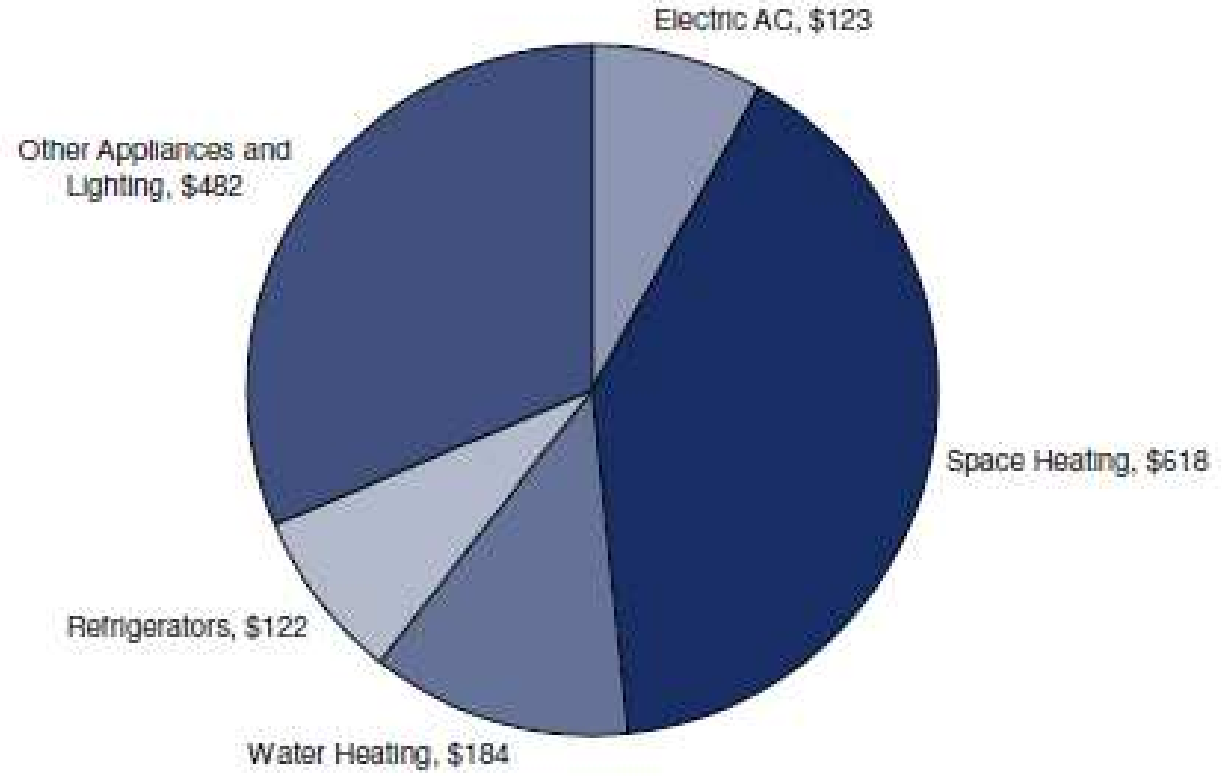
The Facts….

- Energy efficiency is the quickest, cheapest, cleanest way to extend our nation's fossil fuel resource supply.
- Only viable near-term options – supply options take 2-7 years
- It is not the energy we need, but the services it provides, and energy efficiency is a direct substitute for the production and combustion of a fossil energy resource.

Home Energy

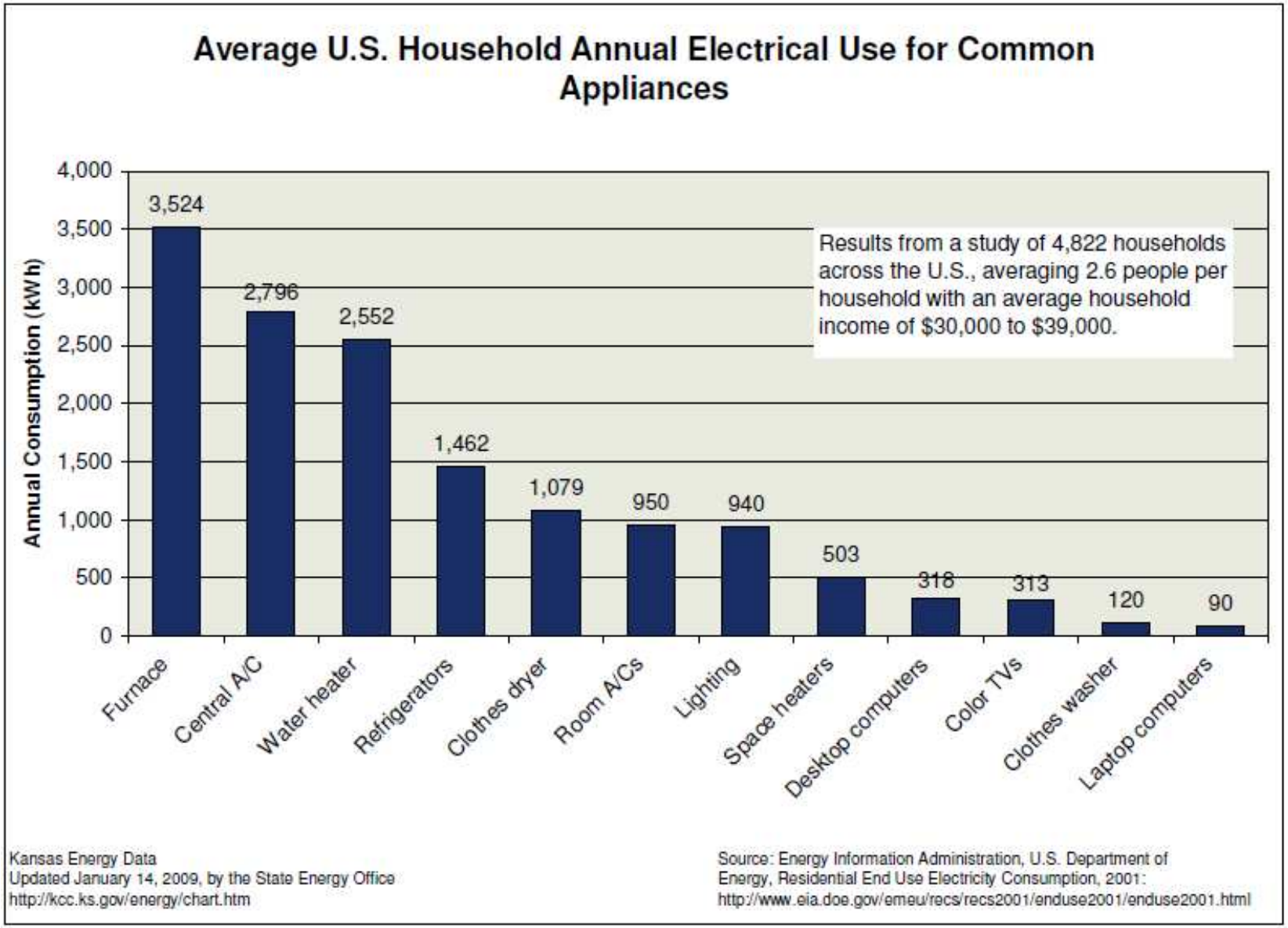
- **Building Thermal Envelope** includes walls, roof, windows, and all boundaries that separate the inside of your home from the outside weather.
- **Space Heating and Cooling** focuses on the selection and efficient use of heating and cooling equipment.
- **Lighting and Appliances** helps consumers choose energy-efficient appliances and provide tips for operation.
- **Green and Energy-Efficient Building Programs** establish energy and environmental ratings to encourage and reward higher level of energy and environmental performance.

Average Annual Household Energy Expenditures in the Midwest



Kansas Energy Data
Updated January 14, 2009, by the State Energy Office
http://kcc.ks.gov/energy/chart.htm

Source: Energy Information Administration, U.S. Department of Energy, Residential Energy Consumption Survey, 2001:
http://eia.doe.gov/emeu/recs2001/datailcalbs.html#appliances


Average U.S. Household Annual Electrical Use for Common Appliances
Annual Consumption (kWh)
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
3,524
2,796
2,552
1,462
1,079
950
940
503
316
313
120
90
Furnace
Central A/C
Water heater
Refrigerators
Clothes dryer
Room A/Cs
Lighting
Space heaters
Desktop computers
Color TVs
Clothes washer
Laptop computers
Results from a study of 4,822 households across the U.S., averaging 2.6 people per household with an average household income of $30,000 to $39,000.
Kansas Energy Data
Updated January 14, 2009, by the State Energy Office
http://kcc.ks.gov/energy/chart.htm
Source: Energy Information Administration, U.S. Department of Energy, Residential End Use Electricity Consumption, 2001:
http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html

Typical Wattages of Various Appliances*

- Aquarium = 50–1210 Watts
- Clock radio = 10
- Coffee maker = 900–1200
- Clothes washer = 350–500
- Clothes dryer = 1800–5000
- Dishwasher = 1200–2400 (using the drying feature greatly increases energy consumption)
- Dehumidifier = 785
- Electric blanket- *Single/Double* = 60 / 100
- Fans
  - Ceiling = 65–175
  - Window = 55–250
  - Furnace = 750
  - Whole house = 240–750

*U.S. Department of Energy, Energy Efficiency and Renewable Energy
http://apps1.eere.energy.gov/consumer/your_home/appliances/index.cfm/mytopic=10040

Typical Wattages of Various Appliances*

- Hair dryer = 1200–1875
- Heater *(portable)* = 750–1500
- Clothes iron = 1000–1800
- Microwave oven = 750–1100
- Personal computer
  - CPU - awake / asleep = 120 / 30 or less
  - Monitor - awake / asleep = 150 / 30 or less
  - Laptop = 50
- Radio *(stereo)* = 70–400
- Refrigerator *(frost-free, 16 cubic feet)* = 725

*U.S. Department of Energy, Energy Efficiency and Renewable Energy http://apps1.eere.energy.gov/consumer/your_home/appliances/index.cfm/mytopic=10040

Typical Wattages of Various Appliances*

- Televisions (color)
  - 19" = 65–110
  - 27" = 113
  - 36" = 133
  - 53"-61" Projection = 170
  - Flat screen = 120
- Toaster = 800–1400
- Toaster oven = 1225
- VCR/DVD = 17–21 / 20–25
- Vacuum cleaner = 1000–1440
- Water heater *(40 gallon)* = 4500–5500
- Water pump *(deep well)* = 250–1100
- Water bed *(with heater, no cover)* = 120–380

*U.S. Department of Energy, Energy Efficiency and Renewable Energy
http://apps1.eere.energy.gov/consumer/your_home/appliances/index.cfm/mytopic=10040

12 Simple, No-Cost or Low-Cost Tips to Reduce Heating Costs

- **1. Reduce thermostat setting to 68 degrees.**

  Winter heating costs are closely related to interior temperature. Reducing your thermostat setting can save substantially on heating costs. Adding a sweater and a warm pair of socks can go a long way to increase comfort in a cooler house.
- **2. Set back thermostat at night and when house is unoccupied.**

  Setting the thermostat back 10 degrees at night or when the house will be unoccupied can save up to 15 percent on heating costs. While it is true the furnace will have to run more to reheat the house, the energy saved while the home is cooler more than offsets the extra run time to reheat the home.

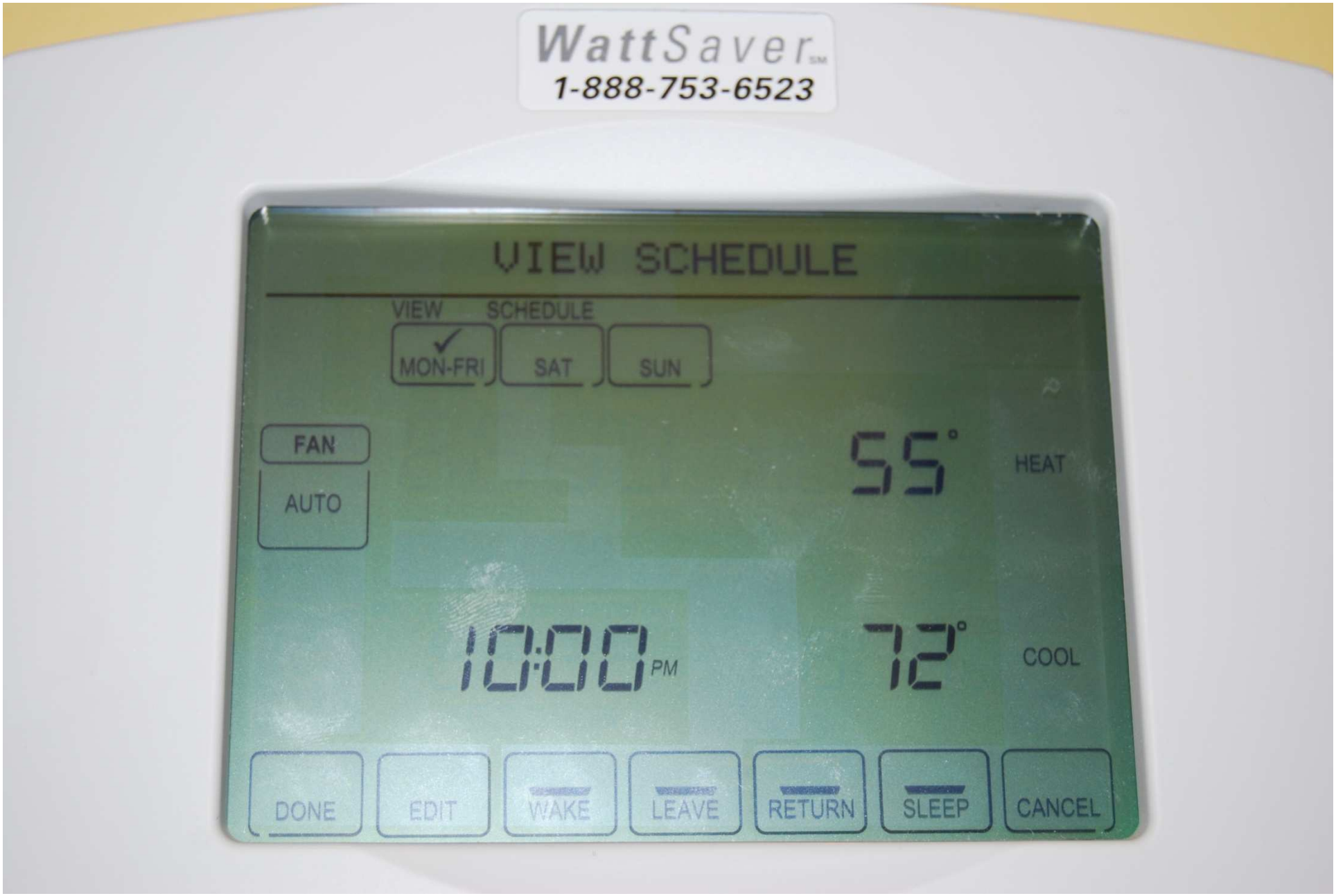
12 Simple, No-Cost or Low-Cost Tips to Reduce Heating Costs

- **3. Install a programmable thermostat.**

  Programmable thermostats provide the ability to lower the home temperature at night and during still have the home warm when you get up or arrive home from work. The prices of programmable thermostats have come down and many can be found for less than $50. If you have a heat pump, a thermostat is required for maximum savings.

- **4. Change furnace filter.**

  Dirty, clogged furnace filters lower the heater's efficiency by preventing proper airflow. Low-cost filters are available from your local hardware store. How often you will need to change vary, but you should check the filter monthly. When you purchase filters, always buy two so you have an extra on hand. It helps to write the proper filter size on the outside of the furnace cabinet.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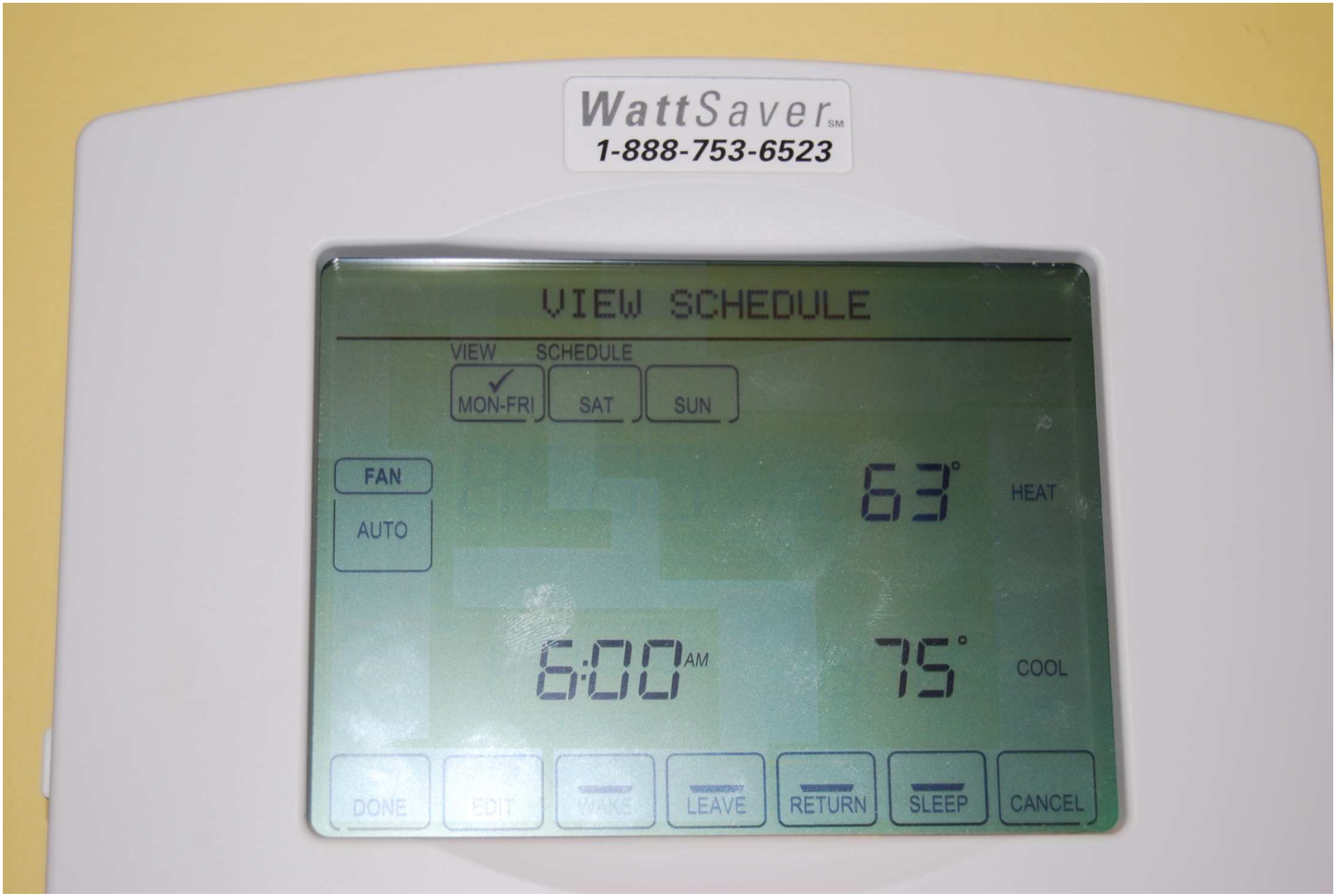
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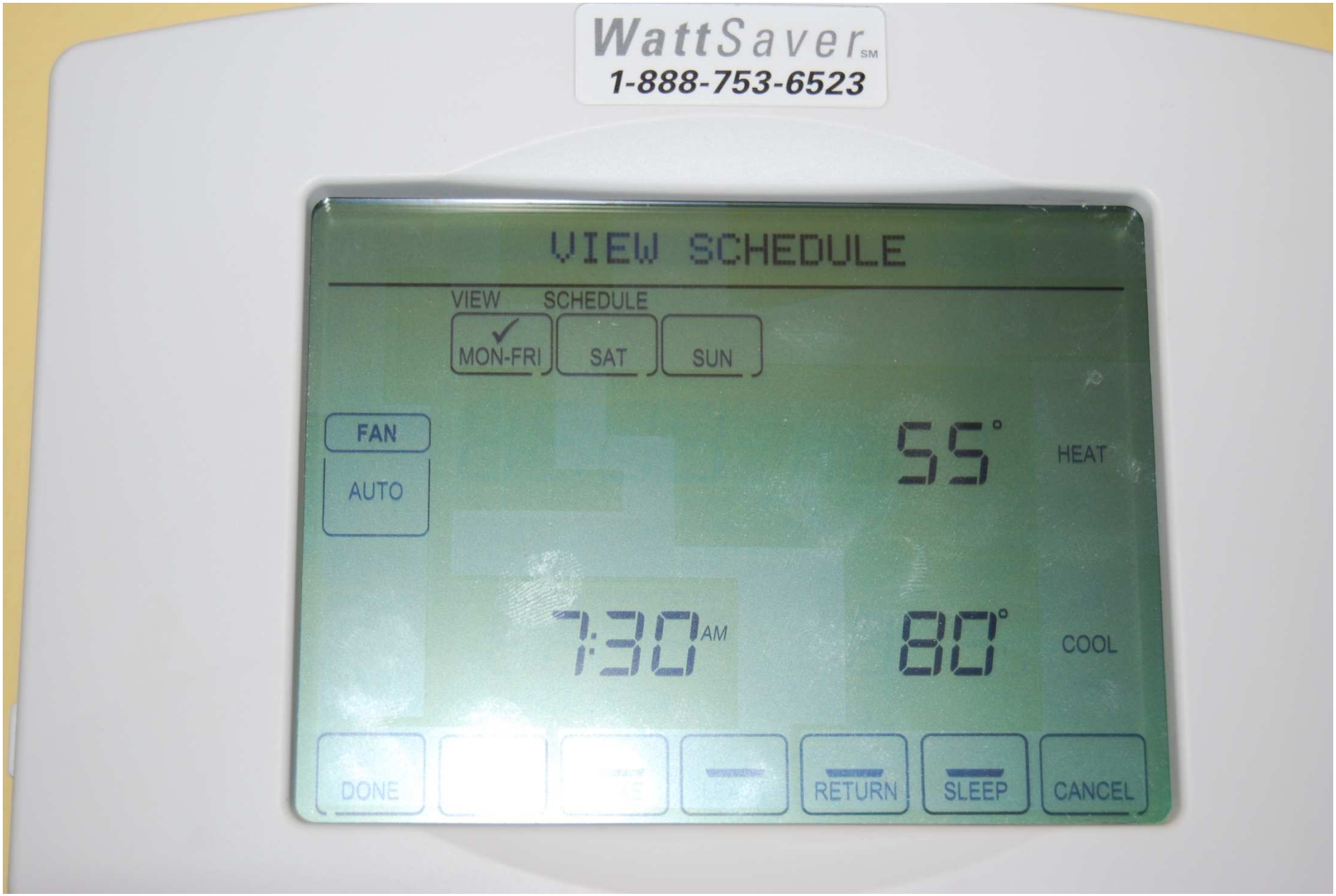
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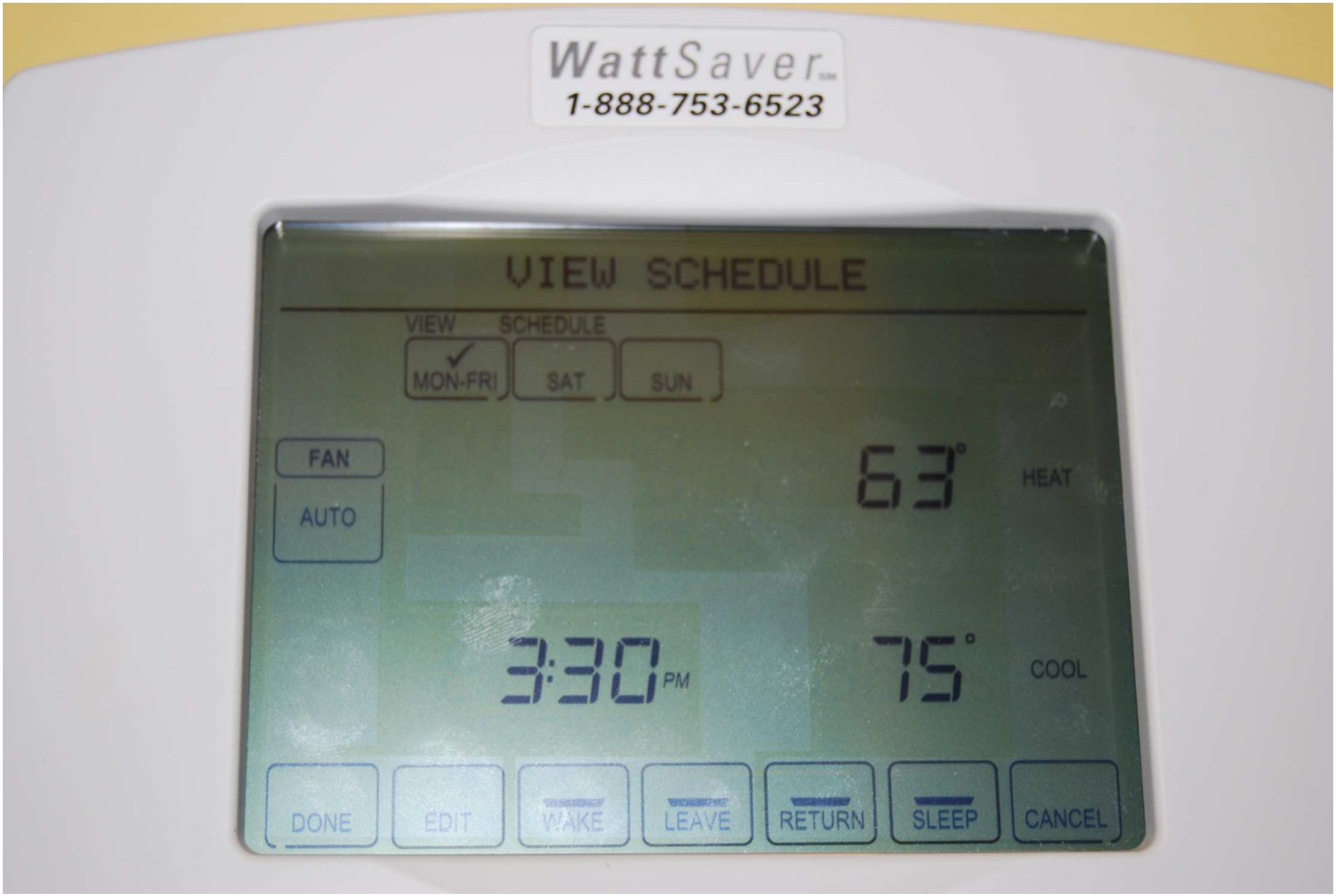
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SLEEP
CANCEL

12 Simple, No-Cost or Low-Cost Tips to Reduce Heating Costs

- **5. Have furnace cleaned and tuned.**

  Having the furnace cleaned and tuned helps ensure a safe and efficient furnace. Tuning may involve resetting the fuel air mixture for proper combustion, and cleaning of the blower and burners to ensure maximum airflow and complete combustion.
- **6. Let sunshine in south windows during day.**

  Open drapes on the south side of your home during winter days and close them at night. Sun angles are low in winter, allowing for substantial solar heating through all south windows. You may want to trim vegetation that shades south windows. East, west, and north windows do not contribute to the winter heating effort.

12 Simple, No-Cost or Low-Cost Tips to Reduce Heating Costs

- **9. Operate kitchen and bath vents minimally.**

  Bath and kitchen vents exhaust heated air and moisture to the outside. If your home is dry during the winter, you may not need to operate these vents at all. However, if you have condensation on windows, operate the vents to remove cooking and bathing moisture but be sure to turn them off.

- **10. Lower the thermostat set point on your water heater.**

  Water temperatures above about 125 degrees are not needed for most tasks. A simple way to check your water temperature is to carefully place the back of your hand under a steady stream of hot water - if it is too hot to keep there, it is too hot.


UNITROL
WARNING
READ ALL INSTRUCTIONS
BEFORE LIGHTING
HOT
WARM
CAUTION
HOTTER WATER INCREASES THE RISK OF SCALD INJURY

12 Simple, No-Cost or Low-Cost Tips to Reduce Heating Costs

- **11. Install a water heater blanket.**

  Older water heaters may not have adequate insulation. Install an insulating water heater jacket. Be careful to follow manufacturer's recommendations and don't cover the thermostat.

- **12. Reduce hot water use.**

  Reducing hot water use is effective in reducing the cost of heating water. Low-flow showerheads reduce water and energy costs. Take showers rather than baths since showering, in general, takes less water than baths. Modern detergents are formulated to work in cold water so wash in cold water. Repair leaky faucets. This will save on water and water-heating costs.

Lighting

- Turn off lights (see the following references for discussions on whether turning lamps off leads to increased lamp replacement)
  - http://apps1.eere.energy.gov/consumer/your_home/lighting_daylighting/index.cfm/mytopic=12280
  - http://www.aircycle.com/media/articles/fluorescentlighting.aspx
- Take advantage of daylight (watch thermal load)
- Task lighting to reduce need for lighting larger areas
- Compact fluorescent bulbs

CFL vs. LED

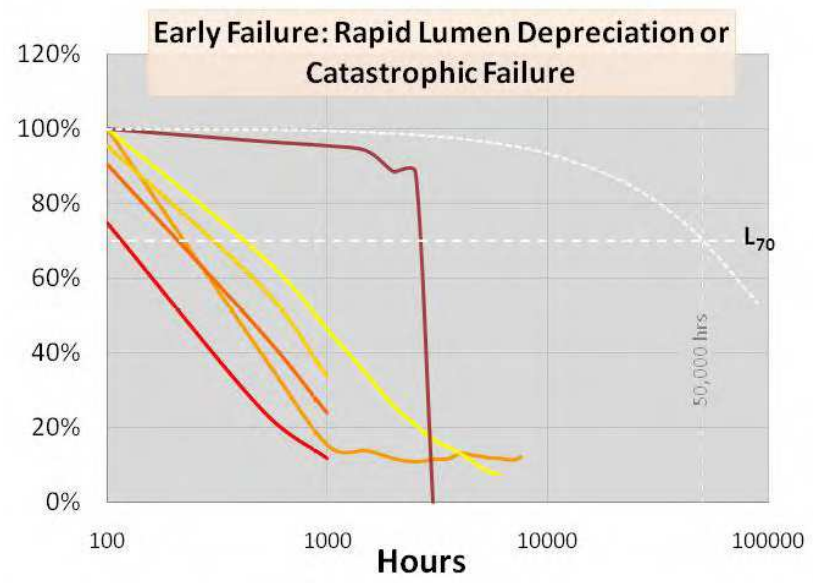
Light	Underneath	Refrigerator	Stove	Dishwasher
CFL (3 minutes)	30.0	6.5	4.2	5.2
LED	7.8	1.2	0.7	1.0

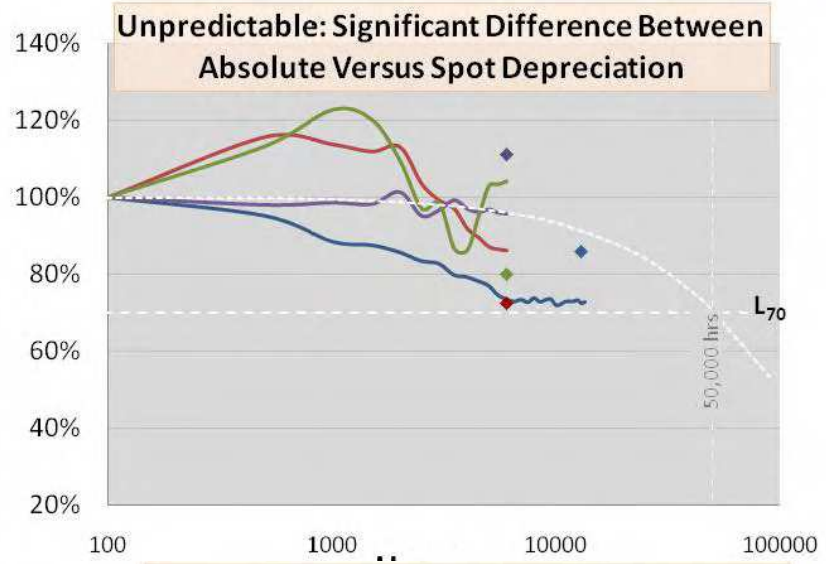
- Sam's Club Cyron PAR38 LED Bulb (4W), Daylight White, 50K hrs, $30.74
- Sam's Club Cyron PAR38 LED Bulb (4W), Warm White - $26.12

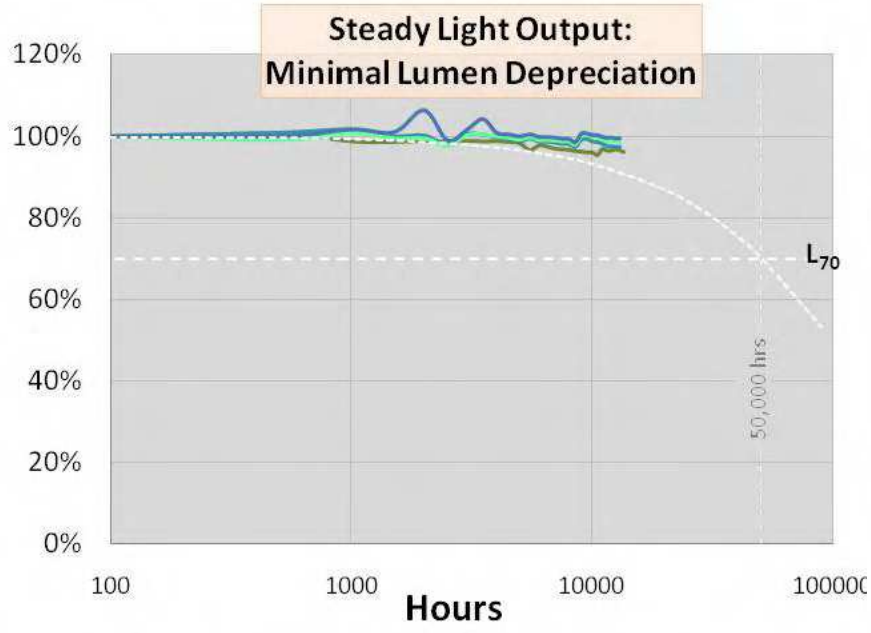
DOE Commercially Available LED Product Evaluation and Reporting (CALiPER) Program

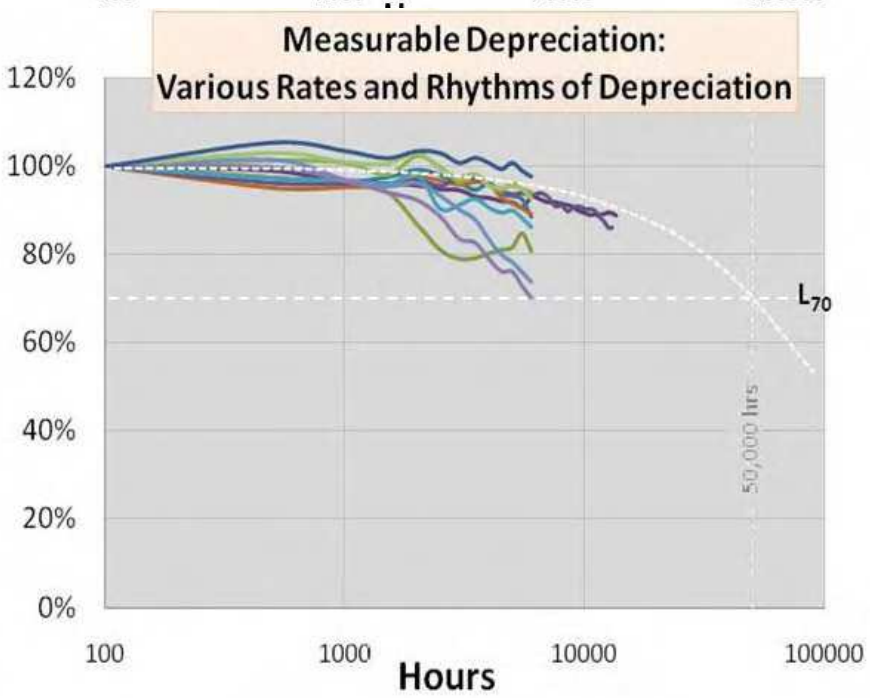
- Due to the range of behaviors and rapid rate of change of SSL technology, buyers and specifiers should be wary of all product life claims.
- More than half the SSL products subjected to CALiPER long-term testing will not provide 70% of initial light output at 50,000 hours and already exhibit significant color shift within the duration of the CALiPER long-term operation.
- About one quarter of the SSL products would not pass a simple 1,000-hour operational test: they do not last as long as a traditional incandescent lamp.
- Testing of SSL and benchmark fluorescent products in Rounds 5 and 9 all concluded that SSL linear replacement lamps are not yet suitable as one-for-one replacement for linear fluorescent lamps.
- SSL linear replacement lamps tested so far do not provide the light output and efficacy levels of the linear fluorescent lamps they aim to replace and have narrower light distribution requiring closer spacing of luminaires.

CALiPER Summary Report, May 2010





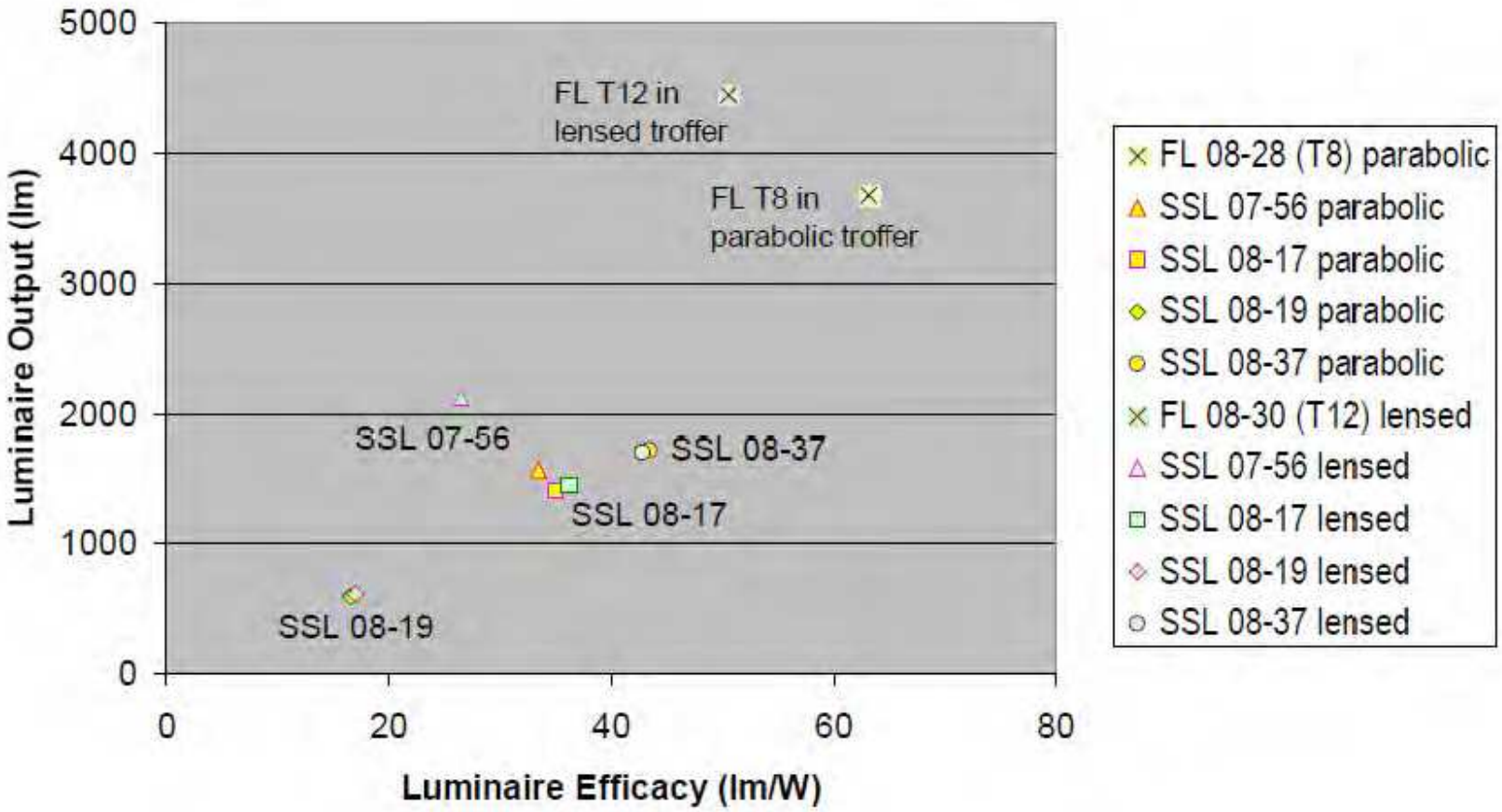




CALiPER Summary Report, May 2010

CALiPER Benchmark Report

LED replacement lamps didn't compete… Even vs. T12



Performance of T12 and T8 Fluorescent Lamps and Troffers and LED Linear Replacement Lamps, January 2009

Economics

Comparison of Life-Cycle Analyses of Compact Fluorescent and Incandescent Lamps Based on Rated Life of Compact Fluorescent Lamp, Rocky Mountain Institute, February 2008

"The research shows that the efficiency benefits compensate for the added complexity in manufacturing, that while rapid on-off cycling of the lamp does reduce the environmental (and payback) benefits of CFLs they remain a net "win," and that the mercury emitted over a CFL's life—by power plants to power the CFL and by leakage on disposal—is still less than the mercury that can be attributed to powering the incandescent."

https://www.rmi.org/images/PDFs/Climate/C08-02_CFL_LCA.pdf

Economics (cont)

- If every home replaced one light bulb with ENERGY STAR bulb
  - Save enough energy to light more than 3 million homes for a year
  - Save more than $600 million in energy costs
  - Prevent GHG equivalent to more than 800,000 cars.

http://www.energystar.gov/index.cfm?c=cfls.pr_cfls

Calculating energy usage

- 60 W bulb x 1 hour, at an average Kansas rate of $0.07/kWh
  - 60W * 1kW/1,000W * 1 hour * 0.07/kWh = $0.0042

Home Energy Consumption

- 99 bulbs, 7-32 W
- 1,336 total Watts for CFL
- 5,515 total Watts for incandescent equivalent
- Savings of 4,179 Watts for just one household! (1,671,600 Watts for 400 households)

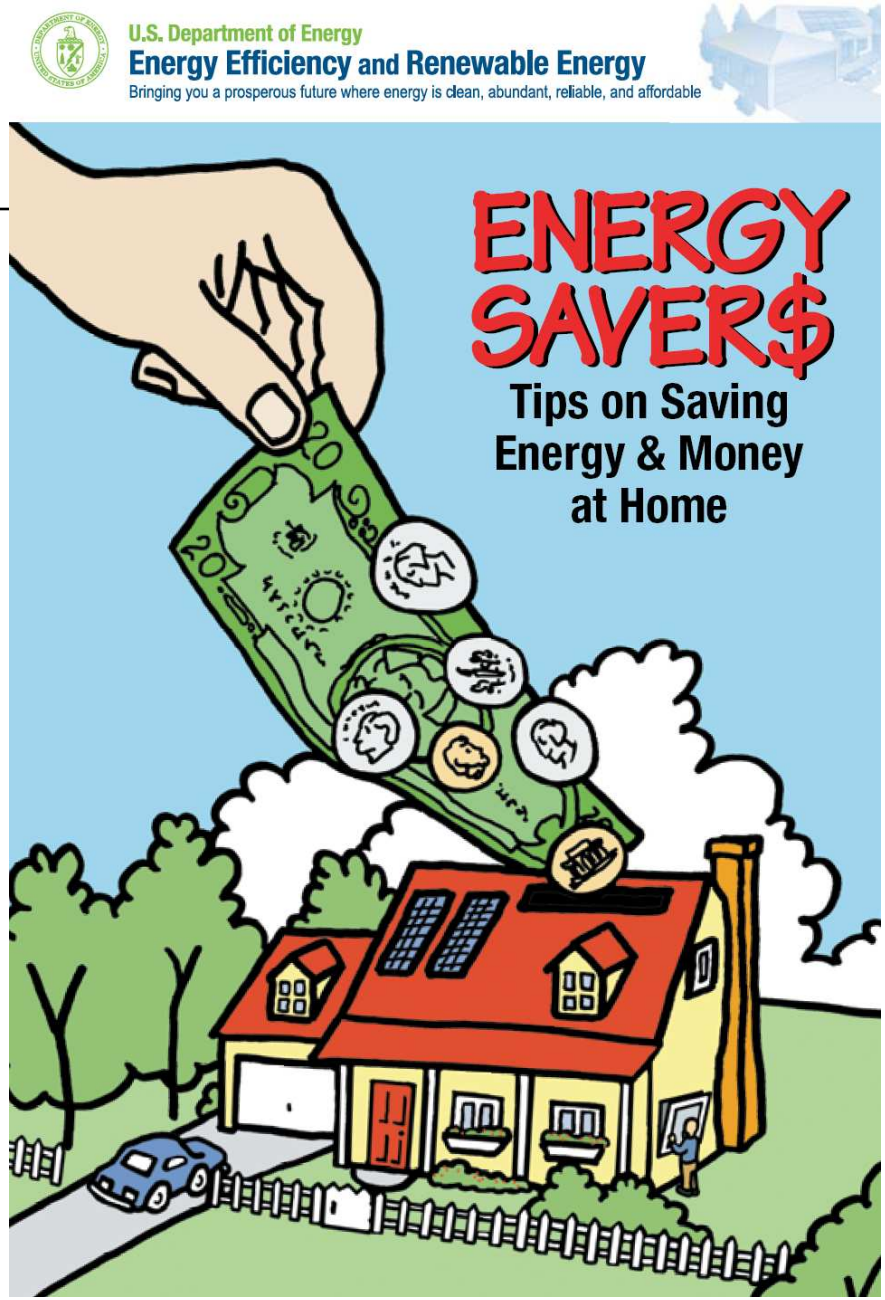
CFL vs. Incandescent			
1 hr/day/yr		10 hr/day/yr	
CFL	Incan.	CFL	Incan.
$34.13	$140.91	$341.35	$1,409.08

Consumer Reports Best CFLs

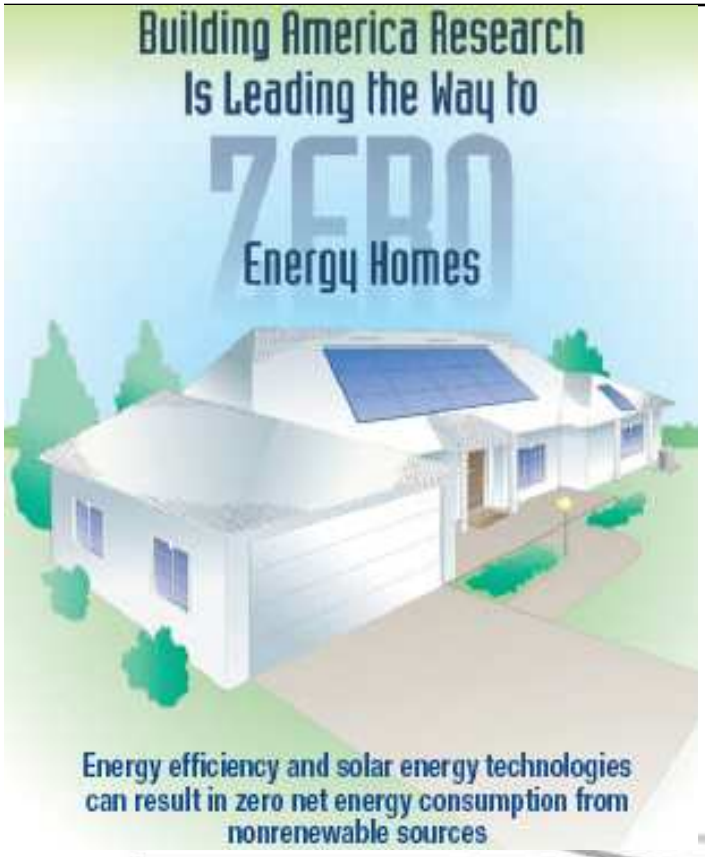
- **GE Long Life 41525, $4.50 (8,000 hours claimed).** All nine bulbs in our test are still shining brightly after 10,300 hours of use. Available at most stores
- **N:Vision 423-599, $2 (10,000 hours claimed).** Seven out of nine bulbs are still on after 10,300 hours. They're available at Home Depot, which promises there is just 2.5 to 3.5 milligrams of mercury in each bulb
- **Feit Ecobulb ESL13T, $2.25 (10,000 hours claimed).** The first batch we tested had a rocky start: Five out of nine burned out by 3,900 hours. But the bulbs have apparently improved. Nine out of 10 in our current test are lighting our lab after 5,300 hours. Available at most stores.
- **Feit Ecobulb Plus ESL13T/Eco, $2.66 (10,000 hours claimed).** Feit claims this greener Ecobulb has just 2.5 milligrams of mercury. It's also doing well in our most recent test: All 10 passed 5,300 hours. At most stores.
- **Great Value CFL13ROHS, $1.75 (10,000 hours claimed).** Wal-Mart's new brand is also off to a strong start: All 10 bulbs have passed the 5,300-hour mark and are still shining.

www.consumerreports.org

- Department of Energy
- http://www.doe.gov/energyefficiency/homes.htm
- http://www1.eere.energy.gov/consumer/tips/pdfs/energy_savers.pdf



Questions?



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