

HOME ENERGY PERSPECTIVE

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Homeowners can work for the larger social goals of energy conservation and environmental protection while they save substantially on their energy bills. Conservation measures can **cut home energy costs by 50% with a modest investment**. Residential energy use accounts for about 22% of total national energy use. Commercial and industrial buildings, which account for another 25%, can use many of these measures to save energy also. Many other countries are considerably ahead of the U.S. in promoting home energy conservation. Future increases in fuel prices will make conservation investment even more cost-effective. Doing a small number of big things, a large number of the free or low cost things or a combination of both will work. **Specific detailed information on home energy conservation appears below.**

Using less fossil fuel energy will help us with **air pollution, acid rain, climate change, oil spills, habitat loss, dependence on foreign imports, and national security**. Retrofitting existing homes is important since 60% of our 214 million dwellings will still be in use in 2050. Other good ways to save energy and money are driving a more fuel efficient car and living in a smaller house. If you drive 20,000 miles a year, you can save \$6667 per year by increasing your fuel efficiency by 25 mpg with gas at \$3 per gallon. Moving to a smaller house (e.g. \$150K vs. 200K) can save more than \$5000 per year in energy plus mortgage payment, taxes, insurance, and maintenance.

The US Energy Information Agency calculated **average home energy use** as: heating 32%, AC 11%, water heating 13%, lights 12%, refrigeration 8%, electronics 5%, and other appliances, etc. 19%. The average home now has 40 products that use electricity. Seemingly small energy uses have significant costs; e.g., a 75 watt bulb left on continuously would cost \$59 per year at 9 cents per KWH. Gas and electric bills should be analyzed to find out how energy uses breakdown. This will help guide choice, e.g., if you spend little on AC, then cooling related conservation measures would be less important. **Energy audits** can be useful in identifying energy losses and the most cost effective conservation measures. Simple online audits are available and some utility companies offer free audits; professional auditors charge \$200 - \$400. (see Website list). The free resources may make a professional audit unnecessary. Audits save money by identifying measures that will not be cost effective. The age and condition of furnaces, AC units,

and appliances provide clues about the need to replace them. An inexpensive device called “Kill a Watt¹” allows you to measure the electrical usage of particular appliances or electronics for comparison with Energy Star levels.

A list of 155 measures to lower energy costs follows. Some may be best done by professionals, but many can be do-it-yourself projects. Some measures will not apply or will not be needed for many homes. Most people can save at least 50% of their energy costs; and 80% of that with some combination of the **54 most effective items shown (in bold)**. Twenty-two of the most effective measures are free or low cost and could save as much as \$200 on energy costs. Doing many of the other 56 free or low cost measures can save up to \$150. Most of these free or low cost measures are also easy to do. Some of the Passive Solar Energy and Energy Efficient Landscaping measures may produce large savings also.

Energy efficient upgrades are more cost effective if they are done **when replacing the particular item anyway or during a general remodeling**. The cost difference vs. products that are not energy efficient is usually small enough to make the upgrade very cost-effective. Two groups of the projects below are so designated. It is often cost effective and a good idea to replace an item before it completely falls apart. It is no fun to be without heat or hot water, for example.

A whole house systems approach is best; measures should be evaluated in combination. If two measures each reduce energy use for heating 30%, the net savings is 51% not 60%. The second measure will save 30% of 70% or 21%, leaving 49% of the original total (70% - 21%) of the original cost. In many cases measures overlap or would be duplicative; e.g., if you have an electronic igniter on your furnace, there would be no pilot light to shut off, or if you have Energy Star windows, storm windows are probably not cost effective. Substantial energy savings will also mean that smaller and less expensive furnaces and air conditioners will suffice, making for additional savings. An Energy Star washer removes more water from clothes thus saving energy use by a dryer. The tighter a house becomes in terms of air leaks, the more need there will be for mechanical ventilation. Some special energy uses, such as swimming pool pumps and heaters, saunas, hot tubs, and aquariums, are not included in this analysis.

¹ Available from Amazon.com

The basic idea of **passive solar heating** is to have ample windows on the south to let in the winter sun with overhangs to keep out the summer sun. Collectors can also be used on solid walls or roofs. Probably 99% of American homes fail to do this effectively. (Only 3% of new homes met Energy Star standards in 2002.) However, passive solar energy can supply substantial heat in many homes without great expense. The Passive Solar section below lists possible measures. Usually, some combination of these measures will produce the best results. Costs and savings will depend on climate, available sunlight, orientation of home, existing windows, and room arrangement. In some cases, passive solar can supply 100% of a home's heat. Homes which face south and have open floor plans have the best potential; modest investment can produce an average of 25% savings on heat in these homes. Energy conservation measures, by decreasing the need for heat, mean that solar will provide a larger percentage of that heat.

Energy Efficient Landscaping, the strategic planting of trees and shrubs can block winter winds or provide shade and cooling or funnel winds toward the home in the summer. Where feasible, this can reduce the need for heating and/or cooling by as much as 30% while producing other benefits as well. A number of **Financing Resources** for energy conservation are available and are listed below and websites providing specific information appear in the Website appendix.

The **cost and savings estimates** are based on an average household in an average 2000 sq ft. home with \$2000 in annual energy costs. Calculations used relevant KWHs or BTUs, average hours of use, average relevant days, and estimated savings factor. Actual costs and benefits for these measures will vary due to climate, building characteristics and differences in utilization. It makes sense to study the list and choose a group of measures that fit your budget and available time in order to find a **combination of measures that work well together**. There will usually be a few measures that will make a big difference.

The energy saving measures are divided into categories based on whether they affect **heating, cooling, ventilation and water heating or appliances, lights, etc.**. They are further categorized by cost and savings estimates. Many of these measures make sense in terms of **air quality, health, humidity, comfort, safety, maintenance of equipment, or aesthetics** as well as saving energy. For example sealing air leaks prevents backdrafting and carbon monoxide spillage from combustion appliances. These measures are asterisked. Details relating to particular measures are given in the footnotes. Lists of useful websites and recommended books are in the appendices.

HEATING, COOLING, VENTILATION AND WATERHEATING

OVER \$200 ---PAYBACK 1 - 5 YEARS, AVERAGE ANNUAL SAVINGS \$62

attic or whole house fan*

insulate attic*

insulate exterior walls*

insulate floor*

insulate heating and cooling ducts

seal air leaks from inside*

seal heating and cooling ducts, use duct sealant/mastic not duct tape

storm windows²

OVER \$200, COST EFFECTIVE IF REPLACING OR REMODELING, AVERAGE ANNUAL SAVINGS \$33

cool roof coating in hot climates

electronic ignition on furnace*

energy efficient hot waterheater

Energy Star furnace

Energy Star windows*³ (see Website List)

heat pump or geothermal heat pump

Heat Recovery Ventilator (HRV) or Energy Recovery Ventilator (ERV)⁴

if re-siding, rigid foam insulation and air barrier under siding

reduce excessive window exposure on north, east, and west sides⁵

energy efficient heater in garage

Energy Star central and room air conditioners

Energy Star dehumidifier for hot weather

evaporative cooler in hot climates

extra vents separate from windows

² If it is not affordable to replace existing windows, storm windows may be good option

³ SHGC, Solar Heat Gain Coefficient measures direct solar radiant heat that gets through glass. To limit heat gain, select products with SHGC ratings below 0.4. In hot climates buy the lowest SHGC available. The U-factor is a measure of conductive heat loss, it is the reciprocal of the R factor. Buy the lowest U-factor you can afford, best products are rated at about 0.15. Casement, awning and hopper windows have half the infiltration of sliding windows. Fixed windows even less. Fixed glass windows can cost as little as one-third as much as operable windows.

⁴ Heat Recovery Ventilator or Energy Recovery Ventilator systems will probably save between \$100 and \$500 per year. HRV and ERV systems cost from \$1500 to \$4000 installed. These systems can recapture 65% to 80% of the heat from the outgoing airstream. ERVs transfer not only heat but also humidity. ERVs can be retrofitted onto existing ductwork for remodeling projects. An ERV is most beneficial in harsh climates, especially where fuel costs are high.

⁵ Solar transmission through windows can account for up to 40% of a home's cooling requirements. Glazing should not exceed 25% of floor area. Glazing should be < 4% of floor area for both north and east, and < 2% on the west.

green roof⁶
heat reclaimer⁷
high placed windows for natural ventilation
humidifier in heating system
improved kitchen, bath, laundry room fans*
induced draft fan on combustion appliances*⁸
insulate basement walls
insulated exterior doors
integrate ventilation into central heating and cooling systems
modulating aquastat on a boiler⁹
outside sources of air for combustion appliances*
polystyrene on outside of slab foundation
proper vapor barriers and vapor retarders in walls and ceiling*
ridge vents at the peak and soffit vents at the eaves*
separate heat zones
vent damper on furnace, hot waterheater¹⁰
windows or vents placed to maximize cross ventilation

UNDER \$200, AVERAGE ANNUAL SAVINGS \$39

Awnings or roller shades on east and west facing windows in hot climates*
glass doors on fireplace
low-e coatings, window films, solar screens, etc.*
maintain, tune up furnace, AC*
programmable thermostat
radiant barrier below the roof
thermal shades, shutters or heavy curtains
use room AC vs. central AC

UNDER \$200, AVERAGE ANNUAL SAVINGS \$13

Energy Star ceiling fan for air movement in summer
Energy Star ceiling fan with vaulted ceilings for winter
movable insulation on window
protect outside doors from wind*
storm doors*

⁶ A green roof is a roof that is partially or completely covered with vegetation and soil, or a growing medium, planted over a waterproofing membrane.

⁷ stovepipe accessory designed to extract heat from flue gases

⁸ a fan that is an integral part of the appliance and is located downstream from the burner

⁹ A device that senses the outdoor temperature and keeps the boiler only as hot as necessary

¹⁰ A device installed in a furnace or boiler's venting system to restrict the loss of heat after the furnace or boiler has been shut off.

FREE OR LOW COST, AVERAGE ANNUAL SAVINGS \$29

close doors and vents in unused rooms¹¹

insulate waterheater

keep waterheater temp at 115*

set thermostat for less energy use, dress appropriately

use fans in summer vs. AC

close fireplace dampers, seal chimney if unused

weather stripping on doors and windows

FREE OR LOW COST, AVERAGE ANNUAL SAVINGS \$15

caulk holes on exterior

clean or replace filters furnace, AC, every 90 days*

close drapes at night in winter

open windows in evening to catch cool breezes*

place plastic sheet on dirt floor in crawlspace

repair broken or cracked windows*

turn off furnace pilot light when not in use

unblock, clean hvac registers, vents*

FREE OR LOW COST, AVERAGE ANNUAL SAVINGS \$3

air transfer grills between rooms and hallways

flush out sediment in waterheater once a year*

foam gaskets on outlets and switches

have cold meals in summer

insulate attic access door

insulate attic fan opening in winter

insulate hot water pipes

minimize use of bath, kitchen fans

remove room AC, seal opening in winter

shade outdoor AC from sun

¹¹ This may cause problems with air circulation in house

APPLIANCES, LIGHTS, ETC.

OVER \$200, COST EFFECTIVE IF REPLACING OR REMODELING, AVERAGE ANNUAL SAVINGS \$45

eliminate freezer
energy efficient clothes dryer
Energy Star dishwasher with booster heater
Energy Star fluorescent lighting fixtures
energy efficient range with electronic ignition if gas
Energy Star refrigerator, smallest feasible
LCD TV vs. Plasma
skylights or sun tunnels for natural light
Energy Star chest freezer vs. upright, smallest feasible
Energy Star clothes washer
Energy Star electronics

FREE OR LOW COST, AVERAGE ANNUAL SAVINGS \$30

air dry clothes, on clothesline or rack
change to CFL lights
dimmer switches on incandescent fixtures*
keep pilot lights off on gas range, especially in summer
make use of natural light when possible*
paint walls in light colors to reflect light
repair leaky faucets*
reset brightness on TV's, monitors
turn off computer etc when not in use
turn off lights when leave room
use area lights vs. whole room lighting*
use energy saving settings on appliances*
use lowest wattage bulbs feasible
use microwave ovens vs. oven
use one higher wattage bulb vs. multiple lower wattage bulbs
wash clothes in cold water

FREE OR LOW COST, AVERAGE ANNUAL SAVINGS \$10

air dry dishes
clean lint filter in dryer*
computer power management¹²
don't use long life incandescent bulbs -- less efficient
keep refrigerator at 37-40, freezer at 5*
keep seal tight on oven door*
keep seal tight on refrigerator door*
LED nightlights and Christmas lights
run washing machine full
take shorter showers
use laptop v desktop computer

¹² Decreases power use when computer is on but not being used

FREE OR LOW COST, AVERAGE ANNUAL SAVINGS \$3

clean filter screen in dishwasher*
clean fridge coils*
defrost freezer before ice builds up*
diverter on dryer vent, vent inside in winter
don't open door of oven unnecessarily
don't overload refrigerator
don't pour hot water down drain in winter, let cool in winter
don't run water unnecessarily*
dust light bulbs
insulate under and around sides of waterbed
keep burners, reflectors clean on range*
keep dryer vent clear*
keep gas flames blue not yellow*
keep oven clean*
keep waterbed covered during day
low flow shower heads, faucets
maintain air circulation around refrigerator*
match pan size to burner size on stove
run dishwasher full
seal food in refrigerator*
take showers not baths
turn electric burners and oven off early
unplug electronics when not in use (use powerstrips)
use cold water handle at sinks when hot water not needed
use kettle or covered pan to boil water
use pressure cookers
use small elect pans or toaster ovens

PASSIVE SOLAR ENERGY¹³ (see Website List)

Cost and payback depend on specifics of climate and home

add thermal mass, if necessary¹⁴
black roof collector¹⁵
clerestory windows facing South
create open floor plan, remove interior walls*¹⁶

¹³ First steps are: Evaluate solar suitability of site and building, Estimate heating and cooling degree days, Calculate solar noon to identify Southern exposure, Estimate possible solar gain from existing windows, Calculate bearing angles for overhang length

¹⁴ Need 8.3 sq ft of wall mass for each sq ft of solar glazing over 7%, if direct contact, mass absorbs more heat.

¹⁵ <http://www.builditsolar.com/Projects/SpaceHeating/BlackRoof/BlackRoofCol.htm>

¹⁶ If passive solar heats house unevenly, separate heat zones may be required.

enclose porch on South side*
increase glazing on South side¹⁷
overhangs or awnings on South side*
passive solar heat to garage
remove obstructions to sun on South side
solar hot waterheater
sunroom, attached greenhouse, greenhouse windows*
thermosiphoning air panel (or solar chimney)¹⁸

ENERGY EFFICIENT LANDSCAPING¹⁹

Cost and payback depend on specifics of climate and home

plant a funnel of trees and shrubs to guide prevailing winds*
plant trees, etc. to block summer sun and cool by evaporation*
plant trees, shrubs close to the east, north and west near house*
plant windbreaks, rows of trees and shrubs*

FINANCING RESOURCES (see Website List)

Energy Efficient Mortgages (EEM)
Energy Improvement Mortgage (EIM)
HUD/FHA Title 1 home improvement loan for up to \$25,000
HUD 203(k) loan to purchase a home in need of repair or modernization
Tax credits, State and Federal
Utility companies rebates for energy conservation expenditures
Utility companies free or reduced rate installations and energy audits
Weatherization-assistance programs for income-qualified homeowners

*Measures that also make sense for reasons other than energy savings (**air quality, health, humidity, comfort, safety, maintenance of equipment, or aesthetics**) are asterisked.

¹⁷ For south facing windows: with passive solar heating...high SHGC (above 0.50 at a minimum). The shading coefficient (SC) of a window tells you how much solar heat can be gained, compared to one layer of clear single glazing (1.00) Should be high for South facing windows, low for others.

¹⁸ <http://www.builditsolar.com/Projects/SpaceHeating/SolarChimney/SolarChimney.htm>

¹⁹ Moffatt, Simon, Marc Schiler et. al., Energy-Efficient and Environmental Landscaping

RECOMMENDED BOOKS

- Anderson, Bruce and Malcolm Wells, Passive Solar Energy, Brick House Publishing, 1994
- Butti, Ken, A Golden Thread, Cheshire Books, 1980
- Chiras, Daniel, The Solar House, Passive Heating and Cooling, Chelsea Green Publishing, 2002
- Cozzi, Guy, Energy Saving Home Improvements from A to Z: Real Estate Investor, Homeowner, Nemmar Real Estate Training, 2004
- Editors of Sunset Books, 136 Best Ways to Save on Your Home Energy, Sunset Books, 2001
- Harley, Bruce, Insulate and Weatherize, The Taunton Press, 2002
- Home Energy Magazine, No Regrets Remodeling, Home Energy Magazine, 1997
- Krigger, John and Chris Dorsi, Homeowner's Handbook to Energy Efficiency, Saturn, 2008
- Moffatt, Simon, Marc Schiler et. al., Energy-Efficient and Environmental Landscaping, Appropriate Solutions Press, 1994
- Reif, Daniel K., Solar Retrofit, Adding Solar to Your Home, Brick House, 1981

USEFUL WEBSITES

PROFESSIONAL ENERGY AUDITS

Residential Energy Services Network (RESNET), Home Energy Ratings System (HERS), RESNET is A national standards making body for building energy efficiency rating systems, <http://www.resnet.us/ratings/overview/resources/primer/HP05.htm>

Home Energy Tuneups, certified energy inspectors, specialized software produces a report which shows savings and costs for energy efficiency improvements. <http://www.hometuneup.com/>

U.S. Department of Energy, Energy Efficiency and Renewable Energy (EERE): directory of 345 energy software tools, http://apps1.eere.energy.gov/buildings/tools_directory/

Home Performance with Energy Star, Contractors participating in a [locally-sponsored Home Performance with ENERGY STAR program](#) can help you cost-effectively improve your home's energy efficiency. http://www.energystar.gov/index.cfm?c=home_improvement.hm_improvement_hpwes

Show Me Home Energy Solutions, professional auditor, questions and answers, lists of benefits about energy conservation, <http://www.showmehomeenergysolutions.com/index.html>

FREE ENERGY AUDITS

Lawrence Berkeley Laboratories, Home Energy Saver, online software estimates costs and savings of most important conservation measures, <http://hes.lbl.gov/>

Energy Efficient Rehab Adviser, provides recommendations, costs and savings estimates for energy conservation projects, <http://rehabadvisor.pathnet.org/index.asp>

Energy and Environmental Building Association, Energy Checklist, detailed checklist for home energy conservation, <http://www.eeba.org/resources/publications/hec/index.html>

U.S. Department of Energy, Energy Efficiency and Renewable Energy, Do-It-Yourself Home Energy Audits, guidelines for conducting audits, http://apps1.eere.energy.gov/consumer/your_home/energy_audits/index.cfm/mytopic=11170

Vectren, Energy Calculators, calculators for energy savings for systems and appliances, https://www.vectrenenergy.com/web/enablement/learn_about/conservation/calculators_i.jsp

Energy Star, Appliances, http://www.energystar.gov/index.cfm?c=appliances.pr_appliances

AIR SEALING AND INSULATION

Energy Star, Do-It-Yourself Guide to Sealing and Insulating http://www.energystar.gov/index.cfm?c=diy.diy_index

Mother Earth News, All About Insulation, excellent guide to home insulation <http://www.motheearthnews.com/Do-It-Yourself/200212-01/All-About-Insulation.aspx>

ENERGY EFFICIENT WINDOWS

The Efficient Window Collaborative, Energy Star Window Performance Criteria, recommended window properties by climate zone, <http://www.efficientwindows.org/energystar.cfm>

The Efficient Window Collaborative, State Fact Sheets, Selecting Energy Efficient Windows, <http://www.efficientwindows.org/factsheets.cfm>

The Efficient Window Collaborative, National Fenestration Rating Council (NFRC), <http://www.efficientwindows.org/nfrc.cfm>

PASSIVE SOLAR ENERGY

Society of Building Science Educators, Pilkington Sun Angle Calculator (SAC), simple method of determining solar geometry variables for architectural design, <http://www.sbse.org/resources/sac/index.htm>

National Renewable Energy Laboratory (NREL), Solar Radiation Data Manual, solar radiation data by location, http://rredc.nrel.gov/solar/old_data/nsrdb/bluebook/

Sustainable by Design, Design Tools, solar angle calculations, <http://www.susdesign.com/tools.php>

Build it Solar, Evaluating Your Site for Solar Energy,
http://www.builditsolar.com/SiteSurvey/site_survey.htm

FINANCING ENERGY CONSERVATION PROJECTS

Residential Energy Services Network, Mortgages, details on Energy Improvement Mortgage and Energy Efficient Mortgage, <http://www.resnet.us/ratings/mortgages/default.htm>

Energy Star, Federal Tax Credits for Energy Efficiency,
http://www.energystar.gov/index.cfm?c=products.pr_tax_credits

Data Base of State Incentives for Renewables and Efficiency (DSIRE), comprehensive source of information on state, local, utility, and federal incentives that promote renewable energy and energy efficiency, <http://www.dsireusa.org/>

U.S. Department of Energy, Energy Efficiency and Renewable Energy, Weatherization Assistance Program, federal program for low income people,
<http://apps1.eere.energy.gov/weatherization/>

Alliance to Save Energy, Energy-Efficiency Home and Vehicle Tax Credits,
<http://www.ase.org/content/article/detail/2654>

Tax Incentives Assistance Project (TIAP), designed to give consumers and businesses information on federal income tax incentives for energy efficient products and technologies passed by Congress as part of the Energy Policy Act of 2005,
<http://www.energytaxincentives.org/consumers/>

Efficient Windows Collaborative, Utility Programs that Offer Incentives and Rebates for Energy-Efficient Windows, <http://www.efficientwindows.org/UtilityIncentivesWindows.pdf>

www.crestonesolarschool.com