Energy and the Consumer

Consumers can control their energy consumption, within limits, if they are aware of energy-conserving habits and their benefits. Utility bills are a score card for both the energy specialist and the consumer to measure whether energy retrofits and behavior changes actually save energy.

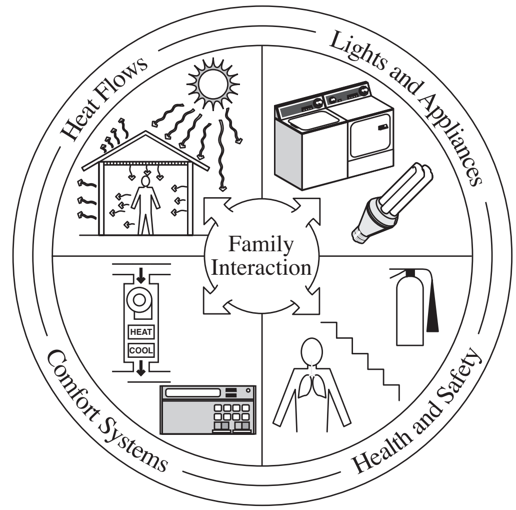
Consumer Education

Consumer education can be one of the most cost-effective energy conservation measures. Households with equal-sized families and identical homes living next door to each other can have vastly different energy costs. Behavioral differences, comfort perceptions, and household operation and maintenance account for this variation.

Utility companies charge consumers for energy consumed within their living units. Educating consumers to adopt energy efficiency is an important part of the energy specialist's mission because behavior is such a major influence on energy consumption.

Setting priorities for occupant interactions is important because there's seldom time to discuss every potential savings opportunity. Consumer education methods succeed best when they consider a family's needs and education level. Customer acceptance depends on the energy-service provider's reputation, professional courtesy, and ability to communicate.

Energy Education



The goal of energy education is a family's understanding of its relationship with the home's energy systems.

Home Electricity Consumption

Indicator	Low	Medium	High
kWh/year	<4000	4000-8000	>8000
kWh/month	<320	320-670	>670
kWh/day	<10	10-20	>22
kWh/person/yr	<1700	1700-3400	>3400

Doesn't include heating, cooling, or water heating. Assumes 2.4 persons per household.

Making a good first impression is important for customer relations. Friendly, honest, and straightforward communication helps create an atmosphere where problems and solutions can be openly discussed.

The most important preconditions for changing residents' behavior are respecting and accepting them as they are. Tolerance and acceptance requires *active listening*—a set of courteous and effective listening habits, including:

- Paying attention and avoiding the urge to interrupt.
- Avoiding stereotyping or judging the speaker.

- Asking questions to clarify your understanding of their concerns.
- Paraphrasing and repeating the speaker's most important concerns to confirm your understanding.
- Empathizing with the speaker—putting yourself in his or her shoes.

The incentive for most learning is the expectation of benefits for the learner. Show customers how behavior changes will benefit them. Comparing the costs of current and alternative behaviors provides valuable information for informed choice. Informed consumers benefit from money savings, better comfort, improved health and safety, and a healthier environment.

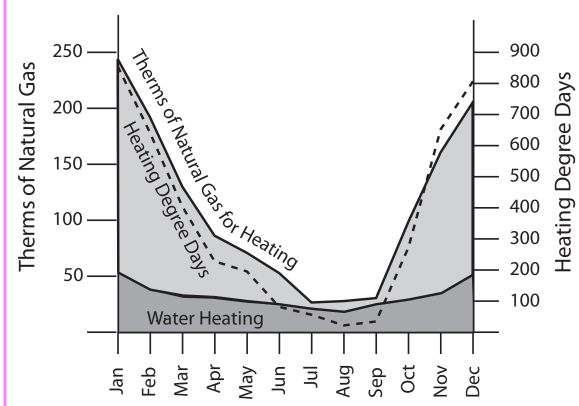
Many retrofits provide a mixture of benefits—one or more may appeal to the consumer. For example, insulation and storm windows reduce energy costs, increase comfort, and reduce condensation. Articulating these benefits leads people to make correct decisions.

People learn best from their own experiences. Ideal learning opportunities occur when residents can make a decision, perform a task, or assist in an energy conservation procedure. For example, showing residents how to program their new automatic thermostat, set their water heater's temperature, or help them find air leaks during a blower door test, can stimulate their commitment to understanding and controlling their home's energy consumption.

Utility Bills

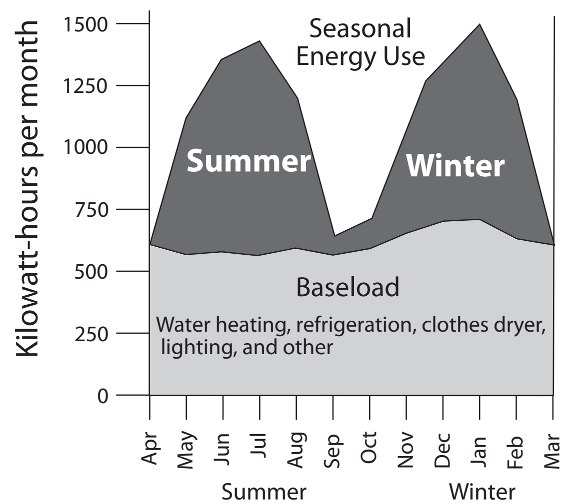
Utility bills are a useful tool to gauge a building's energy efficiency and measuring energy savings from retrofits. Both improvement in comfort and economic benefits from energy conservation are compared to the costs in order to set priorities and make decisions.

Energy Consumption and Heating Degree-Days



Natural gas consumption follows heating degree-days. Graphs like this are helpful for analyzing energy consumption and establishing baseload gas consumption.

Energy Consumption in an All-Electric Home



Energy consumption for an all-electric home shows the variation of both seasonal and baseload energy consumption.

Electricity and natural gas, which comprise almost 90% of residential energy use, are distributed by central utilities that bill customers monthly for service. Utility bills contain a variety of information in addition to the payment

Utility Bill Anatomy

Local Gas and Electric Company

INFORMATION EXPLAINING THIS STATEMENT MAY BE FOUND O NTHE REVERSE SIDE OF THIS FORM
IF YOU HAVE ANY QUESTIONS, PLAEASE CALL US. PHONE 406-555-3456 OR COME INTO OUR OFFICE.

1234 LOCAL STREET
SOMEWHERE, USA 12345

TYPE OF SERVICE	DATES OF SERVICE		NO. OF DAYS	METER READ STATUS	METER READING		METER READ STATUS	KWH/MCF USE	NO. OF UNITS OR KW DEMAND	AMOUNT
	FROM	TO			PREVIOUS	PRESENT				
ELEC RES	DEC08	JAN08	32	ACTUAL	49553	50025.1		472.1		28 04
GAS RES	DEC08	JAN08	32	ACTUAL	4644	4665.2		21.2		125 08
(1)	(2)	(2)	(3)	(4)	(5)	(5)	(6)	(7)	(8)	(9)
TOTAL CURRENT ENERGY CHARGES										153 12

BALANCE FROM PREVIOUS BILL STATEMENT			52 14
PAYMENT 12/29/94	52 14	THANK YOU	52 14
CURRENT ENERGY CHARGES			153 12
TOTAL AMOUNT OWED			153 12

1–Type of service: electricity or natural gas. **2**–Dates of service: beginning and ending meter readings. **3**–Number of days in billing period. **4**–Meter reading status: read by meter reader, read by you, estimated. **5**–Meter reading from the meter's dials. **6**–Energy conversion factor: converts units to energy used. **7**–KWH or MCF used. **8**–KW demand: charge for peak energy demand. **9**–Amount of money you owe for energy used.

amount owed to the utility company—energy consumption, rate information, the bill's time period, and other related information.

The energy consumption for heating and cooling is called *seasonal consumption*. The seasonal consumption varies from month to month depending on the outdoor conditions during the billing period. The remainder is called *baseload consumption*. Baseload varies little from month to month and forms a baseline on an annual energy-consumption chart as shown here in the chart. Sometimes auditors simply check the bill for three months when there was little heating or cooling to estimate the baseload consumption. However, baseload is usually a higher number than the average of the three lowest months. Baseload typically rises in the winter months. More artificial lighting, colder inlet water temperature for the water heater, and increased hot-water use during the winter can increase annual baseload 5–20%, depending on climate. An auditor, needing an accurate baseload, can install a meter on the heating or cooling system to isolate the seasonal consumption from the baseload consumption.

Energy units — Electrical energy is measured in *kilowatt-hours (kWh)*. Natural gas is measured in several ways: *hundred cubic feet (ccf)*, which is approximately equal to a *therm* (100,000 BTUs), or *thousand cubic feet (mcf)*, which is approximately equal to a *million BTUs* (*MMBTU*).

In the year 2012, a therm or ccf of gas cost $0.50 to $1.40. A MMBTU or mcf is 10 times that amount or $5.00 to $14.00. A kilowatt-hour costs $0.06 to $0.15. Oil is $3.00 to $4.50 per gallon.

See "Equalized Heating Energy Cost Chart" on page 292 for a comparison of heating fuel costs.

Service codes, rate codes, and demand — Utility customers pay different per-unit energy costs, depending on whether they are single-family or multifamily, urban or rural, commercial or residential, among other factors. Service codes identify these types of service.

The rate code is a group of numbers and/or letters recorded somewhere on the utility bill, referring to a particular written rate structure used to charge a particular type of customer. The code may specify one price for the first *block* of kWh or therms, and another unit price for the second block, and yet another for the third block. Some utility rates grant a cost reduction for successive blocks of energy consumption, while some levy a cost increase for successive blocks, to discourage customers from wasting energy.

Larger multifamily buildings may pay a demand charge. A demand charge is a separate service charge for the building's peak demand. The peak demand is the maximum amount of energy the building used during a 15-, 30-, or 60-minute interval during the billing month. Sometimes the demand charge is set by the building's maximum 15-minute consumption during an entire year.

Time period and meter reading — The utility bill shows the starting and ending date of the billing period. The meter reading at the beginning and end of the billing period is also shown. Some utilities show the energy consumption or energy cost per day. The time period information is important for comparison to similar periods in past years.

Energy-Efficiency Ratings of Buildings

Utility bills have their limitations as analytical tools for energy specialists because they are sensitive to changes in occupant behavior—and occupant behavior can cloud the effect of an energy retrofit. After the retrofit, utility bills take time to compile, and so it may be a year before the specialist knows if the retrofit had any effect.

Short-Term Energy Monitoring

Short-term energy monitoring can give energy specialists quicker information to evaluate their work. Most fuel-driven devices in residences use energy at a consistent measurable rate. If you know how long an energy-using device operates and its power rating, you can calculate energy consumption by multiplying power by time. For example, a 100-watt (power) light bulb burning for 10 hours uses 1000 watt-hours or one kilowatt-hour of energy. A 100,000 BTUH (power) boiler operating for 10 hours uses one million BTUs (energy).

Two activities are essential to short-term energy monitoring: measuring power and measuring operating time. You can buy a recording watt meter, which measures both power and time, and connect it to the circuit for the refrigerator, clothes dryer, or electric water heater. Measuring the power of a natural gas furnace involves timing the revolutions of the gas meter's dials and multiplying the number of cubic feet per minute times the BTUs per cubic foot of the region's natural gas. An elapsed-time meter can measure the gas appliance's on-time. Some programmable thermostats also record furnace on-time.

Calculating Energy Intensity

A building's energy consumption divided by its floor area measures its energy intensity—a valuable indicator of the building's energy-saving potential. Two factors derived from a residential building's energy consumption are commonly used to gauge its energy efficiency based on the building's area of floor space.

The first factor, used for homes and smaller multifamily buildings in cold and temperate climates, is expressed in BTUs per square foot per heating degree-day (BTU/ft^2/HDD). This factor—often called the *Home Heating Index (HHI)*—gives a means of comparing buildings with different sizes, climate, and energy prices. The home heating index varies from HHI-2 in very efficient homes to HHI-20 or more in the most inefficient existing homes.

Three other energy indexes are used for homes in warm climates, electrically heated homes, and larger residential buildings. These indexes are expressed in annual BTUs per square foot (BTU/ft^2), dollars per square foot, or kilowatt-hours per square foot (kWh/ft^2). These indexes are more useful for buildings whose energy costs are not dominated by heating and not so directly related to heating degree-days. Extremely efficient residential buildings may only use 5,000 BTUs/ft^2 or 2 kWh/ft^2 annually for all uses, while very inefficient buildings may use 100,000 BTUs/ft^2 or 40 kWh/ft^2 annually.

ENERGY STAR® Program by EPA

CHANGE FOR THE BETTER WITH ENERGY STAR

The Environmental Protection Agency, in cooperation with the Department of Energy, has created a brand that identifies the most energy-efficient products on the American market.

Before proceeding with any inspection of the building, the auditor should examine the building's energy costs and compute one of these three factors. This will give the auditor a preliminary idea of the opportunity for energy conservation measures.

See "Calculating Loads With Computer Programs" on page 75.

For example, if a home has an HHI of 5, the auditor expects to find a well-insulated home with a good air barrier and an efficient heating system. Opportunities for conservation are probably limited. An HHI of 20, however indicates an inefficient home with a very large opportunity for energy conservation.

A multifamily building using 80,000 BTUs/ft^2 is probably an excellent candidate for energy-efficiency improvements. Energy intensity of 25,000 BTUs/ft^2 indicates a very energy-efficient multifamily building.

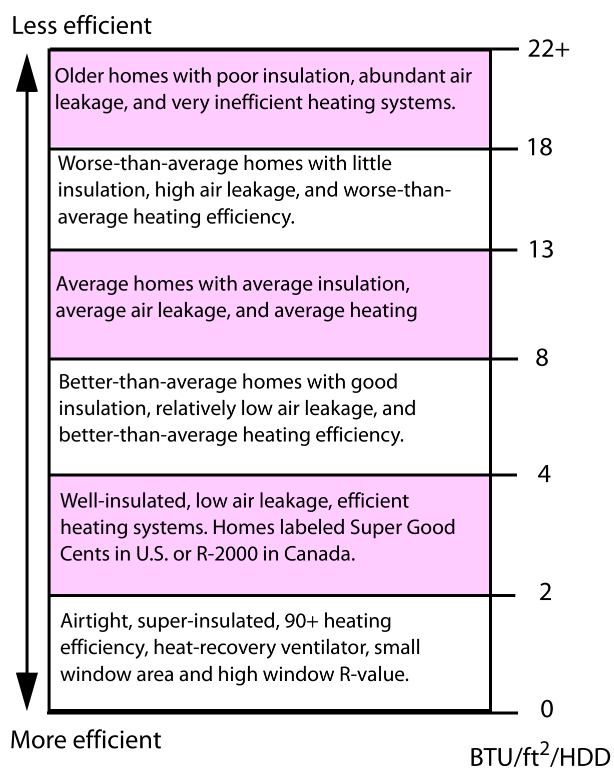
See "Energy Indexes for Buildings (Total Energy)" on page 26 for values of these factors and what they indicate about a building. See "Analyzing Annual Energy Costs" on page 277.

Home Energy Rating Systems

Home energy rating systems (HERS) are standardized methods of rating a home's energy efficiency. The purpose of HERS are to provide consumers with information to compare homes, which they are considering purchasing, and to qualify consumers for energy-efficient mortgages. HERS programs are typically run by state rater organizations, in collaboration with Realtors, builders, appraisers, consumer groups, environmental groups, and the secondary mortgage market. The largest U.S. rating organization is the Residential Energy Services Network (RESNET).

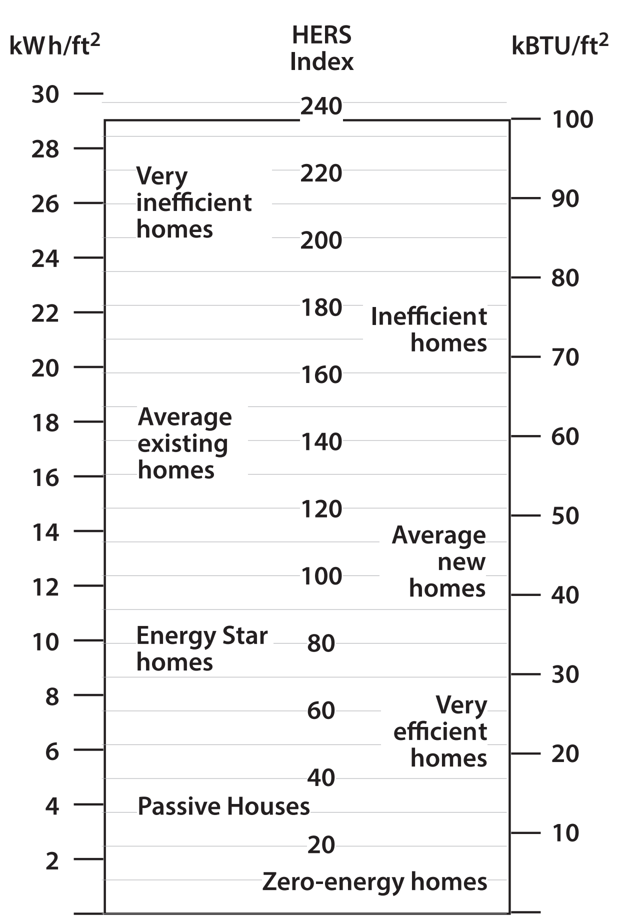
See "Energy-Efficiency Organizations" on page 306.

Home Heating Index



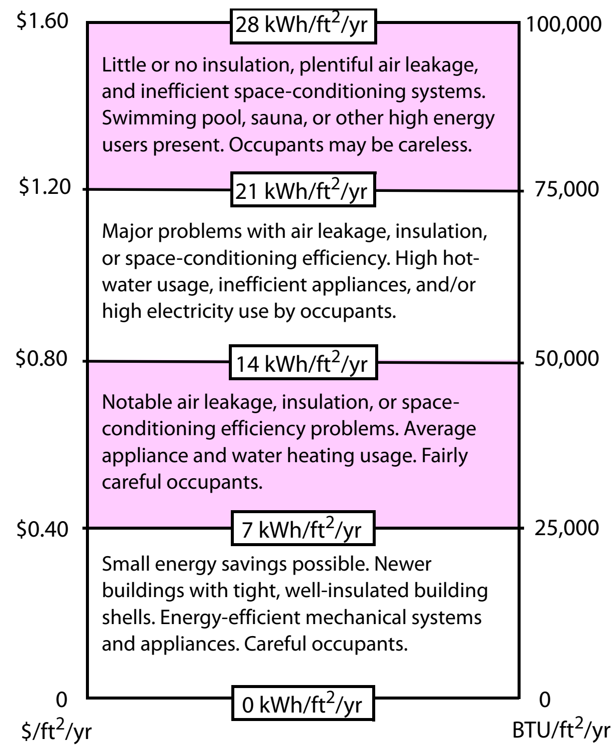
The Home Heating Index, measured in annual BTUs per square foot per heating degree day, is a common way of comparing homes heated by fossil fuel. Electrically heated homes and multifamily buildings have a different scale $^1/_3$ to $^2/_3$ smaller than the one shown.

HERS Rating with Other Energy Indexes



The HERS index is common way of rating the energy-efficiency of homes. This chart compares the HERS index with two other energy indexes: thousands of annual BTUS per square foot and annual kilowatt-hours per square foot.

Energy Indexes for Buildings (Total Energy)



Annual dollars per square foot, BTUs per square foot, or kilowatt-hours per square foot are rough indicators of building energy efficiency. To calculate annual kWh/ft2 or BTU/ft2, convert all home energy to either BTUs or kWh and divide by occupied square feet. See Appendice A-5 Analyzing Annual Energy Costs.

The home energy rater gathers data about the home and enters into a home-rating computer program. This rating program compares the rated home with a reference home and assigns the home a point score depending on its relative efficiency. The reference home, built to the International Energy Conservation Code (IECC), represents a rating of 100 and a zero-energy home represents a rating of 0. A rating of 85 or lower can earn the home the ENERGY STAR label or a tax credit.

Along with the rating report, the home owner receives a list of cost-effective options for improving the home's energy rating. The cost of improvements can often be included in a mortgage and will pay off in long term energy and comfort benefits.

Cost-Effectiveness of Energy Retrofits

Cost-effectiveness describes how quickly an energy retrofit returns its initial investment. Several common ratios are used to measure cost-effectiveness. The simplest ratio is dividing the initial cost by the annual savings to find the number of years—payback period—a retrofit takes to pay its initial cost back in savings. Dividing the annual savings by the initial cost (giving the inverse of the first ratio) is the annual return expressed as a percent. For example, if a retrofit costs $1000 and saves $100 per year, its payback period is 10 years and its annual return is 10%.

Life-cycle costing is a more sophisticated way to measure cost-effectiveness. The theory of life-cycle costing is that, when contemplating any action, one should compare the *life-cycle cost* of taking the action with the life-cycle cost of not taking the action. If the life-cycle cost of acting is less than the cost of inaction, then one should act.

For example, an existing heating system will use $1200 per year over the next 25 years, costing $30,000 if no action—retrofit or replacement—is taken. A new heating system costing $5000 will use only $600 per year or $15,000 over 25 years. The new system's initial cost of $5000 plus its fuel costs of $15,000 equals $20,000. Replacing the heating system is cheaper than not replacing it, so it's prudent to replace it.

Some government and utility programs require using a *savings-to-investment ratio (SIR)*, sometimes called a *benefit/cost ratio (BCR)*. These are ratios of the life-cycle savings divided by the initial investment. In the above example, take the life-cycle savings ($30,000 – $20,000 = $10,000) divided by the initial cost of $5000 to arrive at an SIR of 2. An SIR of 2 means that the retrofit will pay for itself twice during its life-cycle.

Actual calculations of SIR or BCR are usually performed by computers, because they are quite complex. These calculations adjust future savings for energy cost escalation, inflation, and for the banking principle that future monetary savings are less valuable than current cash.