

Home Energy Briefs



#8 KITCHEN APPLIANCES

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Longer workdays, greater commutes, and dual-income households mean fast food and ready-to-eat meals have become a common part of the American lifestyle. Many of us eat out almost as often as we cook our meals at home.¹ As our careers and social lives become more global, so do our sources of food. Food is a complex resource with connections to many different parts of our lives. Yet, no matter how your lifestyle affects what you eat, there are many opportunities to lower the energy and environmental impacts related to the life cycle of food products. Such opportunities arise in food purchase and storage, preparation and cooking, and food disposal.

This Brief will cover the following topics:

- **Food and the impacts of what we eat;**
- **The refrigerator and freezer:** One of your home's largest electricity consumers;
- **Cooking appliances:** How you use them is just as important as what you use; and
- **Food waste:** How to deal with it responsibly.

FOOD AND THE IMPACTS OF WHAT WE EAT²

Before the frozen peas arrive in the freezer or the loaf of bread arrives in the breadbox, they have already produced environmental and energy impacts based on where they were grown or produced, how they were processed, and how far they were transported. Accordingly, our choices of food and where we buy it have varying impacts on the planet. For example:

- Foods that contain corn syrup or that are cooked in oil tend to have large amounts of embodied energy because they are manufactured using energy intensive processes.

- Foods derived from local or regional sources require four to seventeen times less fuel to transport and cause the emission of four to seventeen times less carbon dioxide than foods that are distributed nationally. Buying locally produced food through farmers' markets or community-supported agricultural (CSA) programs has been shown to be cheaper on average than buying food distributed nationally and stocked in a supermarket. Also, a dollar spent locally generates almost twice as much value for the local economy than a dollar spent at a chain store, because a local store generally buys more of its goods and spends more of its profits within the community, not outside of it.
- Similarly, purchasing imported foods uses four times as much energy and causes four times as much carbon dioxide emissions as purchasing domestic foods. The air transportation of food is extremely energy intensive.
- Organic products leave much smaller energy and environmental footprints than their conventionally-produced counterparts.

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REFRIGERATORS AND FREEZERS

As Figure 1 below shows, advances in technology have cut refrigerator energy use by over 60 percent in the past twenty years. In addition to (mandatory) federal standards, Energy Star® has set even higher (voluntary) standards. In 2004 alone, Energy Star appliance standards improved refrigerator efficiency by 15 percent over 2001 Energy Star standards. Yet, some 2003 models exceeded the 2004 Energy Star standards by another 8 to 40 percent (see Figure 2).

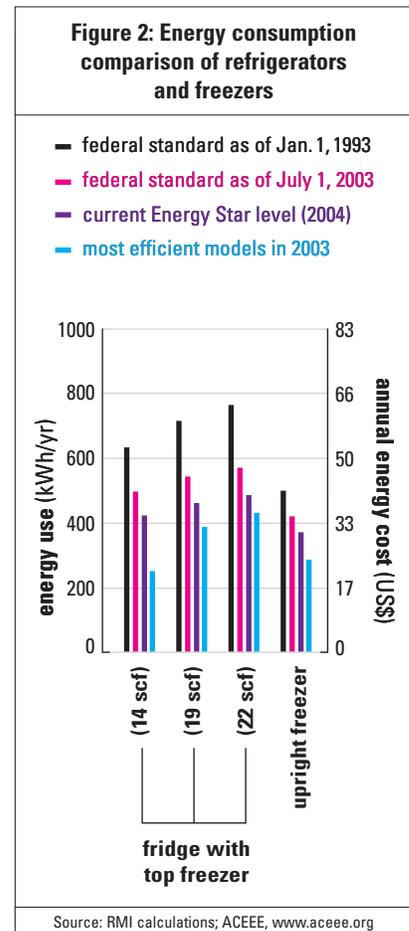
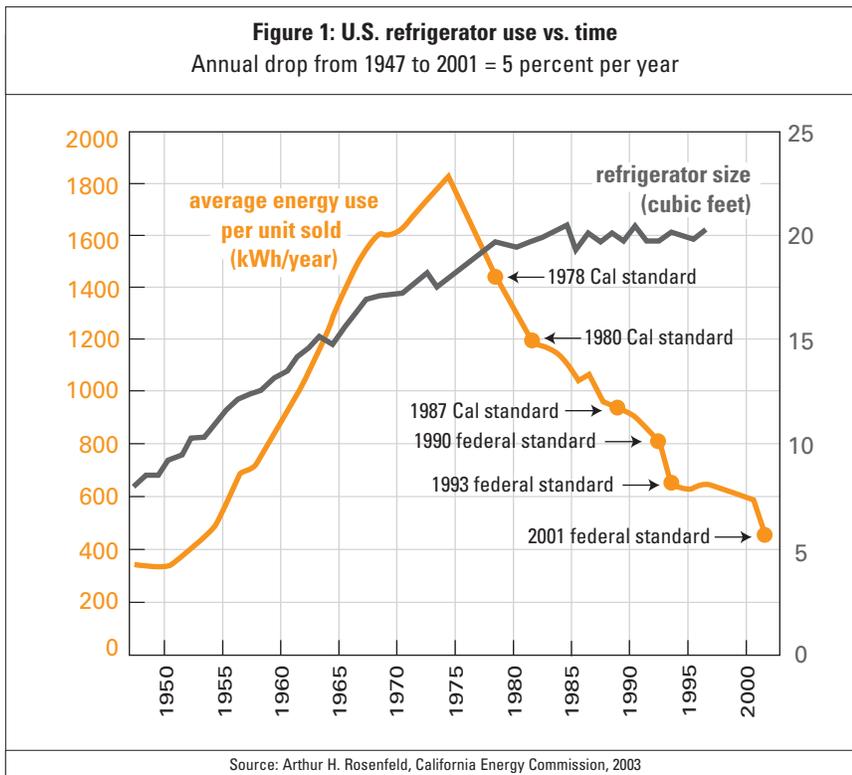
Models predating 1993 could be costing you up to \$140 per year in electricity! If you have a model purchased between 1993 and 2001, it is probably still inefficient and

could cost \$60 (assuming \$0.083 per kilowatt-hour) per year to run. A new refrigerator could save up to two-thirds of that electricity, which may make it more cost-effective to replace your existing refrigerator *before* it dies a natural death. In addition, since all of the electricity used by your refrigerator is converted into waste heat that is vented out the back of the fridge and into the living space of the house, buying an efficient new fridge can also save you money by reducing air conditioning requirements.

Since there is significant variation in the efficiency of various models, it definitely pays to shop around for the right model when you are in the market for a fridge (see Table 1). Carefully consider the style, size, and features you want, and the energy implications.

Some other things to consider:

- Side-by-side refrigerator/freezers use roughly 10 percent more energy than similarly sized freezer-on-top models.
- Larger units tend to be more efficient in terms of kilowatt-hours per cubic foot, but overall they consume more electricity than smaller units. Be careful not to oversize. Select a model and size that meets your needs and no more.
- It is much less expensive to run one big refrigerator than two small ones, assuming roughly equal efficiencies.
- For the convenience of through-the-door water or ice dispensers, you'll pay extra in the purchase price, have higher electric bills, and may even pay more in repair bills. Automatic icemakers typically increase refrigerator energy use by 10 to 20 percent.



Greater efficiency through refrigerator maintenance

While people generally know to not dawdle with the refrigerator door open, there are many other ways to make a refrigerator operate more efficiently:

- **Check location:** You can boost energy efficiency by making sure your refrigerator is not located in direct sunlight or next to a heat source such as the oven or the dishwasher. Also, be sure that air can circulate freely around condenser coils by leaving a space between the back of the refrigerator and the wall or cabinets.
- **Keep the fridge top uncluttered:** A cluttered fridge top can block the circulation needed to keep the compressor working efficiently.
- **Check temperature:** The refrigerator's main compartment should be set between 36°F and 40°F and its freezer should be set between 0°F and 5°F. Use a thermometer to check the actual temperature, and adjust the thermostat if necessary. Your refrigerator can use 25 percent more energy if it is set 10°F colder than recommended levels.
- **Clean condenser coils at least once a year:** Unplug the unit and brush off or vacuum the condenser coils (located on the back of the refrigerator or behind the front grill).
- **Check door seals:** Keep door seals or gaskets clean and in good condition. If the seals can't hold a dollar bill firmly in place, they may need replacement. Your appliance dealer can get them for you. New seals are not cheap, however, and this may be a good time to decide whether to buy a new, more efficient refrigerator. (This test may not work if your fridge has magnetic seals; in this case, put a bright flashlight inside the refrigerator, dim the lights in the kitchen, and check for light leakage.)
- **Check "power-saver" switch:** Many refrigerators have small heaters in their walls to prevent condensation build-up on the outside. Likewise, many refrigerators have a "power saver" switch that when turned on, will turn this heater off. Ensure that this switch is on if you have the option to do so and you don't see any condensation on the outside of the fridge.
- **Defrost as needed:** If you have a manual defrost or partial automatic defrost, be sure to defrost the unit regularly. Buildup of ice on the coils makes the compressor run longer, wasting energy.

Table 1: The top energy efficient refrigerators and freezers (2003)

Type	Brand	Model	Size (cubic feet)	Energy use (kWh/yr)	Annual energy cost (\$) **
fridge with top freezer, AD	Sun Frost	RF-16	14.31	254	21
	Kenmore	6397*30*	18.79	392	32
	Kenmore	7328*30*	21.55	437	36
fridge with bottom freezer	Kenmore	7295*	18.52	475	39
side-by-side	Kenmore	5360*20*	25.57	582	48
single-door	Sun Frost	R-19	16.14	204	17
compact fridge & freezer	Absocold	GARD562MG10R/L	5.60	268	22
compact fridge	Avanti	RM901W	8.70	230	19
upright freezer	Avanti	VM799W	7.50	292	24
chest Freezer	Wood's	C09NAD	9.00	251	21
AD = Automatic Defrost					
*Implies a digit or letter that varies depending on certain features of the model					
**Energy cost based on 8.3¢/kWh electricity and 60¢/therm for gas					
Source: Alex Wilson, et al., <i>Consumer Guide to Home Energy Savings, 8th ed.</i> , (American Council for an Energy Efficient Economy, 2003).					

- **Cover liquids and foods:** If your freezer is almost empty, put in a few water-filled plastic containers. The water will retain the cold much better than empty space, especially when the door is open, and it reduces the need to run the compressor.
- **Buy a manual defrost freezer:** This type of fridge consumes 35–40 percent less electricity than comparable automatic-defrost models. They also cost less to run, and they do a better job of storing food, since auto-defrosters remove moisture and can dehydrate food (freezer burn).
- **Consider chest (top-loading) freezers:** They are 10–25 percent more efficient than upright (front-loading) models because they are better insulated and less warm air enters the freezer compartment when the door is open.

Disposing of your old refrigerator or freezer

Since old refrigerators contain chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs) in their refrigerant (Freon) and foam insulation, it is important to dispose of retired units in an environmentally responsible manner. In addition, the other materials (metals, plastics, etc.) can be recycled, thereby conserving resources. Contact your local recycling center, utility or refrigerator retailer to find out what programs exist in your area to recycle refrigerators and freezers. In addition, think twice before reselling your refrigerator on the used refrigerator market. If it is inefficient enough for you to discard, it is not efficient enough to pass on to another household.

COOKING APPLIANCES

Cooking appliances are also major energy consumers in the home. If you live in a hot climate, the heat generated by cooking can increase energy costs by forcing your air conditioning to work harder. Unlike most other appliances, ranges, ovens, and stovetops aren't subject to government minimum-efficiency standards, and manufacturers tend to concentrate more on styling, ease of cleaning, and other matters than energy efficiency. Thus, new stovetops and ovens are not achieving breakthroughs in energy saving technologies. Cooking habits, not technology, represent the biggest potential for energy savings in the kitchen. Tests by the U.S. Bureau of Standards have shown that some people use 50 percent more energy than others to cook the same meal. In the sections to follow, we suggest cooking strategies that will help homeowners save energy using their existing cooking equipment.

Gas or electric?

To power an electric appliance, fuel must be converted into electricity at a power plant and then transmitted over long distances before reaching your home, typically requiring three or four units of fuel to produce one unit of electricity. Gas cooking appliances use much less energy than their electric counterparts because the fuel is delivered directly to the home and used directly for cooking. Keep in mind the choice of gas or electricity depends more on whether or not you have a hook-up for the gas and where the gas is coming from.

A gas appliance costs less than half as much to operate as an electric one, provided it's equipped with an **electric ignition** instead of a pilot light. **Pilot lights** burn only small amounts of gas, but they burn it 24 hours a day, 365 days a year. In the average household, this waste is roughly equal to the amount of gas actually used for cooking. The required elimination of gas pilots on all new gas ranges has saved 40–50 percent of the energy they use.

Fridge factoid

The costliest refrigerator is the one you don't really need but run anyway—you know that old one keeping a six-pack cold in the garage or basement. Retire it from service (and don't resell it!).

Gas appliances require proper ventilation to dispel hot air and gases out of the kitchen (recirculating the air through a filter isn't adequate). If your house is well-sealed for energy efficiency, this proper ventilation becomes even more essential, as improper ventilation can allow dangerous fumes to diffuse through your home. Unfortunately, there is no perfect ventilation system. Warm air evacuated by a range hood fan or downdraft ventilator is replaced by cold outside air, which places additional demand on your heating system and poses the risk of back-drafting from the furnace and fireplace. Some fans use make-up air ducts to offset this effect; otherwise, make sure your fan isn't too powerful for its purpose.

Stovetops

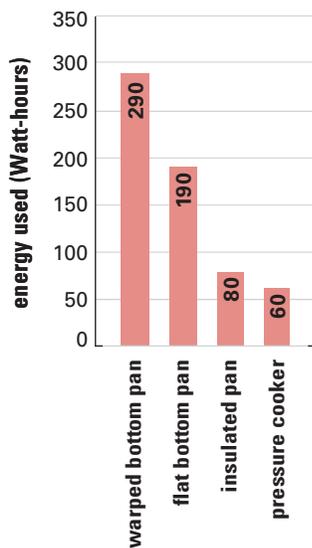
Currently, there are many different styles of stovetops besides the classic electric coil element or gas burner. *Solid discs* are heated by electrical resistance just like coil elements—the only difference is that they're solid for easier cleaning. However, because they have more thermal mass, they take longer to heat up and typically use more electricity. *Radiant elements* are electric coil elements placed under heat-resistant ceramic glass, again for easy cleaning. They too take longer to heat up, although their energy efficiency is comparable to that of standard electric coil elements. *Halogen elements* use a quartz-halogen lamp to radiate heat to the ceramic glass surface, while *magnetic induction elements* heat metal pans directly by exciting the metal molecules magnetically. Halogen and induction stovetops are both more efficient (80 percent compared to 70 percent) than standard coil elements. However, they are more expensive, and induction stovetops require that you use only iron or steel pots and pans.

Whatever kind of stovetop you use, the following tips will help reduce the amount of energy you use in preparing meals:

- Cover pots with lids to prevent heat from escaping. This allows you to lower the heat input and can reduce energy use by up to two thirds.

- Minimize heating requirements by using the smallest pan and burner possible. If you cook with gas, don't turn up the flame too high if you're using a small pot. A good rule of thumb for gas cooking is if you see the flame anywhere on the side of the pot, you've probably got it set too high. Turn it down so the flame is only heating the bottom of the pot.
- When boiling, use as little water as needed to do the job.
- On electric stovetops, use only flat-bottomed pots and pans that make full contact with the element. A warped or rounded pot will waste most of the heat (see Figure 3). Gas stovetops heat rounded pots more efficiently.
- Keep metal grease plates under burners clean, or line them with aluminum foil, to reflect heat more effectively up at the cookware.
- Always keep in mind that there could be a more efficient appliance in your kitchen to do the job than the stovetop. For instance, by cooking food at a higher temperature and pressure with a pressure cooker, cooking time is reduced dramatically and energy use is cut by 50–75 percent (see Figure 3). For example, dried beans do not have to be presoaked for a pressure cooker and only take 20 minutes to cook! Crockpots are also very efficient for cooking soups and stews. For heating water, electric kettles use about one-third less energy than a regular kettle heated on a stovetop. Also don't forget about toaster ovens for small dishes as they use only one-third to one-half the energy of conventional electric ovens.

Figure 3: The energy needed to boil 1.5 liters of water on a stovetop varies significantly based on the type of cookware used



Source: E SOURCE, Residential Appliances, Cooking Appliances

Ovens

Conventional ovens or ranges are inherently inefficient because in order to heat up food, they must first heat up about 35 pounds of steel and a large amount of air. Tests indicate that only about 6 percent of the energy output of a typical oven is actually absorbed by the food. When it comes to ovens, your best bet for saving energy is to use it only when cooking large dishes or batches, and to opt instead for a smaller appliance, such as a toaster oven or microwave, whenever possible.

Of all the various electric ovens available, convection ovens are thought to be the most efficient, yet their high performance is mostly based on the assumption of full load use—cooking full dishes. Like conventional ovens, convection ovens are less effective when you are cooking one small dish. Ovens with a self-cleaning function are more energy efficient solely because they have more insulation to withstand the higher temperatures sustained during the cleaning cycle. However, if you use the self-cleaning function more than once a month, you'll use more energy than the insulation saves.

Ovens and ranges can also contribute to overheating your home in the summer, which increases air-conditioning bills and can make the house unpleasantly hot. If you have an air-conditioner, remember that the less energy wasted in heating food, the less work your air conditioner will have to do to keep your home cool. Here are some more tips for making optimum use of your oven:

- Cook several dishes at the same time in the oven, or cook larger portions and reheat for another meal. Reheating takes less energy than cooking, and you'll have fewer dishes to wash;
- Bake with ceramic or glass pots and pans. This will allow you to lower the oven temperature by about 25°F;

Table 2: Energy costs of various methods of cooking the same meal

Appliance	Temperature (°F)	Appliance capacity/rating	Time	Energy used	Energy cost (\$)*
electric oven	350	2000 watts	1 hr.	2 kWh	0.17
convection oven (elec.)	325	1853 watts	45 min.	1.39 kWh	0.12
gas oven	350	122 Btu/hr	1 hr.	0.122 therm	0.07
frying pan	420	900 watts	1 hr.	0.9 kWh	0.07
toaster oven	425	1140 watts	50 min.	0.95 kWh	0.08
crockerpot	200	100 watts	7 hrs.	0.7 kWh	0.06
microwave oven	"High"	1440 watts	15 min.	0.36 kWh	0.03
*Energy cost based on 8.3¢/kWh electricity and 60¢/therm for gas					
Source: Alex Wilson, et al., <i>Consumer Guide to Home Energy Savings</i> , 8th ed., (American Council for an Energy Efficient Economy, 2003).					

- Use thermometers or timers to avoid overcooking;
- Don't cover oven racks with foil—this reduces heat flow and increases cooking time;
- Turn the oven off a few minutes before your food is ready; the oven will remain hot enough to finish cooking the food; and
- If you have a self-cleaning oven, plan to clean it right after you've finished baking something so it doesn't have to heat up a second time.

Microwave ovens

As Table 2 shows, microwave ovens use up to two-thirds less electricity than conventional electric ovens. Microwaves heat food directly by exciting water and fat molecules in the food. They don't waste energy heating air and metal, and they don't generate surplus heat that burdens your air conditioner. Tips for efficient microwave cooking include the following:

- Keep inside surfaces clean so the microwave radiation can penetrate food effectively;
- Plan ahead—defrosting food in a microwave may be convenient, but defrosting it at room temperature is free; and
- Zapping pre-packaged microwavable meals often uses more energy than cooking from scratch, if you count the energy used in processing, precooking, packaging, and transportation.

FOOD RELATED WASTE

The amount of food waste and food packaging waste going into U.S. landfills is enormous and largely unnecessary. EPA states that food scraps in 2001 alone accounted for 26 million tons of waste in the United States. Meanwhile, materials used heavily in food packaging (like glass and plastic), accounted for another 38 million tons of waste.³ Some things that you can do to reduce this waste include:

- **Composting food scraps:** You can place odor-free containers under the sink, as well as composting bins in a corner of your yard, to collect the food scraps. The end product is a wonderful fertilizer for flowerbeds, gardens, and lawn;

- **Recycling/reusing bottles:** Considering that a bottle is one of the easiest food-related products to reuse and recycle, it is surprising more bottles are still finding their way into landfills. Currently, only about 21 percent of glass bottles and 36 percent of plastic bottles are recycled in the United States.⁴ There is much more that we can do, so please help recycling become a common activity in your community by recycling glass and plastic bottles and other products.
- **Buying food in bulk:** If you are able to incorporate it into your lifestyle, buying in bulk usually requires less packaging and is also cheaper. However, be careful with this practice as it is very easy to buy more food than you need, which can then spoil and cause you to waste more in the end.

SUMMARY

Having an energy efficient kitchen means understanding the energy consumption of the appliances in your kitchen, the energy life cycle of the food that comes into it, and all of the wastes that leave it. No matter what your lifestyle is, there are numerous energy efficient practices that you should consider. The options in this Brief range from locating your refrigerator away from heat sources, to using pressure cookers, to sizing appliances to match the job to be done. Last, but certainly not least, don't forget to minimize the amount of waste that your kitchen sends to the local landfill. Composting and recycling are great ways to achieve this.

ADDITIONAL RESOURCES

Earth911 — This site is designed to help you find a local recycling center for old appliances or beverage containers, along with many other items. This website will also provide mail-in sources if there is not yet a recycling center near you (www.earth911.org).

Local utilities — Offer rebates for replacing older refrigerators and freezers, which will give even more monetary savings. To find out more about what programs are being implemented in your area, contact your utility. Locate their internet address or other contact information on your billing statement.

Real Goods — Offers many different types of composting bins. There are many other places on the web to find composting supplies as well, such as **Nature of New England** (www.realgoods.com/shop/shop6.cfm?dp=603 and www.nature.com/composttumblerbins.htm).

Alternative Farming Systems Information Center — Supported by the USDA, this site offers information on organic, sustainable, and community supported agriculture. It also offers a database of CSAs around the country (www.nal.usda.gov/afsic).

American Council for an Energy-Efficient Economy (ACEEE) —

Publishes *Consumer Guide to Home Energy Savings* annually, which lists brands and models of appliances and their annual energy use and cost. It also includes a comprehensive brand-name list of the most efficient refrigerator and freezer models in all sizes and styles (www.aceee.org).

NOTES

1. Organisation for Economic Co-operation and Development, *Sustainable Consumption: Case Study Series; Household Food Consumption: Trends, Environmental Impacts and Policy Responses*, (France: OECD, December 2001), JT00118490.

2. N.S. Jungblut & R.W. Tietje, "Food Purchases: Impacts from the Consumers' Point of View Investigated with a Modular LCA," (Zurich: Natural and Social Science Interface [UNS], Department of Environmental Sciences, ETH Zurich – Swiss Federal Institute of Technology, 2000), pp.134–142.

3–4. EPA (Environmental Protection Agency), "Municipal Solid Waste, Basic Facts," (Washington DC: EPA, Undated), www.epa.gov/epaoswer/non-hw/muncpl/facts.htm.



Contact your local utility or energy office for information on rebates that may be available in your area on the purchase of new energy-efficient appliances. This publication is intended to help you improve the resource efficiency of your home. You should use your best judgment about your home, and seek expert advice when appropriate. Rocky Mountain Institute does not endorse any products mentioned and does not assume any responsibility for the accuracy or completeness of the information in this Brief. Written by Sarah Goorskey, Andy Smith, and Katherine Wang. © Rocky Mountain Institute 2004.

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