The U.S. Congress, presidential candidates, lobbyists, and political commentators have focused much of their attention lately on the need for policies to limit the United States’ contribution to climate change. They promote and debate cap-and-trade systems, stricter automobile fuel economy standards, investments in renewable energy and “clean coal,” and other policies to change the behavior of energy and manufacturing corporations. The debates presume that these policies will reverberate through the entire economy, and their advocates seem willing to wait—in some cases for decades—for that to happen.

These policy discussions have been strangely silent about a huge reservoir of potential for reducing carbon emissions and mitigating climate change that can be tapped much more quickly and directly. U.S. households account for about 38 percent of national carbon emissions through their direct actions, a level of emissions greater than that of any entire country except China and larger than the entire U.S. industrial sector. By changing their selection and use of household and motor vehicle technologies, without waiting for new technologies to appear, making major economic sacrifices, or losing a sense of well-being, households can reduce energy consumption by almost 30 percent—about 11 percent of total U.S. consumption.

Potential savings of this magnitude have existed for at least three decades. It is therefore reasonable to ask why the potential remains largely unfulfilled and what can be done to achieve it. Lack of financial incentives may be one answer, but as the analysis in this article shows, much of the unfulfilled potential for reduction is achievable at low-, no-, or negative-cost. Other partial explanations include difficulties in financing expensive home retrofits, limited ability of renters to change energy use in owners’ buildings, and the average householder’s limited amount of time and attention. All these explanations are important and deserve policy attention if potential savings are to be realized.

Perhaps crucially, however, households lack accurate, accessible, and actionable information on how best to achieve potential savings through their own steps. From a householder’s perspective, a desire to reduce carbon emissions, even combined with knowledge that doing so has net financial and environmental benefits, is insufficient to yield effective action unless that person knows which actions will produce the benefits. Available evidence indicates that although many householders are motivated, they lack the necessary knowledge to act. Moreover, their beliefs about which actions are most beneficial are often mistaken, and the most readily available sources of behavioral advice are not helpful.

When strategies are proposed for households, they often appear in laundry list format, giving little or no priority to effectiveness. It is easy for households that want to cope with rising gasoline prices and heating and cooling bills to respond by taking small actions under the impression they are saving energy, while they are actually making a negligible dent in their personal energy consumption. What are the most effective actions that households can take to save energy, and how can policymakers at all levels help households achieve these savings?
Beliefs about Climate Change and Energy Conservation

Research on public attitudes and opinion on climate change and energy conservation indicates that a near-majority or majority of Americans believe that climate change is real, that it is caused by human action, that reduced energy use is part of the solution, and that personal actions can contribute to reducing climate change. In early 2008, majorities reported that they are using less energy at home and buying energy-efficient appliances, and a near majority reported using less gasoline. Thus, most U.S. residents want to make behavioral changes that reduce their greenhouse gas emissions and many believe they are doing so.

The most extensive research on what consumers believe about the energy-saving potential of household actions was conducted around the energy crises of the late 1970s and early 1980s. For example, a team at Michigan State University asked 400 randomly selected Michigan residents how much they paid per year in home energy bills, which actions could save on these costs, and how much they believed they could save by each action. Their responses were compared with the estimates of home energy specialists. Householder and expert estimates often diverged, sometimes by a factor of four. Householders emphasized highly visible actions that can reduce energy use if repeated regularly, such as lowering winter thermostat settings and turning off lights, and they overestimated the potential energy savings from these actions. Respondents were far less likely to name actions with higher energy-saving potential but low visibility, such as installing storm windows, and they underestimated how much energy these actions could save. Average householders saw most of the potential for energy savings in curtailment—cutting back on normal and desired activities—whereas the energy experts saw the greatest potential in efficiency—investing in home equipment that lowers energy costs without sacrificing desired energy services. Comparable recent data are not available, though some researchers are beginning to revisit the topic.

Much in the political culture has reinforced the equation of energy conservation and sacrifice. During the energy crisis of the late 1970s, President Jimmy Carter—who took energy efficiency seriously—once appeared on national television calling for energy conservation while seated in a sweater by a fireplace. President Ronald Reagan was widely quoted as saying, “Energy conservation means being too cold in the winter and too warm in the summer!” Similarly, Vice President Dick Cheney belittled energy conservation, saying that “Conservation may be a sign of personal virtue, but it is not a sufficient basis for . . . energy policy.”

Available Information: Mixed Signals

The media information most readily available to the American public today does little to counteract the idea that saving energy is mainly about curtailment. Further, this information is not in a form that is likely to lead to action. For example, Al Gore’s well-known movie An Inconvenient Truth emphasizes the seriousness of the global climate crisis, argues that it can be solved with present and foreseeable technology, and says that all citizens can play a meaningful role in the solution. But it does not offer more. The film spent only its last few minutes on mainly technological solutions. Specific individual and household actions appeared only briefly, superimposed on the credits at the end of the film. Given interest-driven campaigns to minimize the threat, messages about the seriousness of the problem may be important to motivate people to act rather than deny the threat, but such messages have a poor track record of producing measurable behavioral change by themselves.

The public needs more direct and coherent advice concerning household and individual actions. The demand for such advice is commonplace and appears to be increasing. We see the following anecdote replicated often: British Prime Minister Gordon Brown commented in an interview during the Live Earth Concert in July 2007, “People are asking, ‘What can I do?’ When I go [a]round the country and I meet people, they say to me, ‘Look, if we knew what we could do to make a difference to helping the planet, then we would do it.’”

An informal survey of books and articles that offer individual advice shows that it is usually offered in forms that are unlikely to lead to effective action. Most typical are long and unranked lists of recommended actions. For example, The Live Earth
Global Warming Survival Handbook, the 160-page “official companion to the Live Earth Concerts,” offers 77 “essential skills to stop climate change” in a rather complex and unranked format. Similarly, a Time magazine cover story in April 2007, reviews “51 Things We Can Do to Save the Environment.” The 51 things, which range from changing light bulbs to compact fluorescents (CFL) to ditching your mansion for a smaller house, are not ordered by impact. There are many other such examples.

When people are faced with a laundry list of advice, they may feel confused and overwhelmed, and consequently take no action, or they may carry out one or two actions—probably the easiest to remember and perform. However, the behaviors that are easiest to remember and perform, for example, turning out lights when leaving rooms, tend to have minimal impact on climate change. Thus, long and unranked lists of behaviors are likely to be ineffective at best and may even be counterproductive, if they lead people to feel satisfied that they have done their part after accomplishing very little.

Moreover, the advice often reinforces householders’ misconceptions about how much impact their actions are having on the environment instead of countering them. Only three of the 77 essential skills to stop climate change in The Live Earth Global Warming Survival Handbook involve efficiency-increasing actions (essential skill #3: changing from incandescent to CFL light bulbs; essential skill #6: “Green Your Ride,” which includes keeping your tires properly inflated; and essential skill #14: “Green Your Home,” which includes installing or upgrading insulation and buying Energy Star appliances). The reader can judge the appropriateness of the remaining essential skills, including, compost your kitchen waste using worms (#13), build a bat house (#44), and “if all else fails...buy a camel” (#68). Similarly, only five of Time’s 51 things (change your light bulbs; ask the experts for an energy audit of your home; check the label; cozy up to your water heater; and check your tires) involve actions that increase energy efficiency. The emphasis is not being put on the most effective actions.

The failures of past communication campaigns for energy conservation and the failures and successes of public health communication show that it is much more effective to focus campaigns on a very small number of specific actions that can make a real difference and disseminate the message repeatedly through multiple media outlets, using sources that are credible to target audiences. Where possible, the messages should arrive when audience members are poised to make choices about the issue the message addresses (for example, in public health, in the doctor’s office or at the cigarette counter). A necessary first step is to identify which actions are the most effective.

The Most Effective Actions

A behavioral analysis of U.S. energy consumption yields a short, ordered list that shows the most effective immediate and low- or no-cost actions individuals and households can take, as well the most effective actions with higher initial costs. Although this analysis is new, the method used to conduct it is not. The analysis, based on U.S. government statistics, is presented in terms of energy consumption and conservation rather than carbon emissions and reductions. However, 84.9 percent of total energy consumed in the United States and 86.0 percent of energy consumed by U.S. individuals and households results from carbon-emitting fossil fuel combustion. Further, carbon emissions and energy consumption are highly correlated by economic sector: households and individuals (excluding transportation) consume 21.7 percent of total U.S. energy and generate 21.1 percent of total U.S. carbon emissions; industries consume 32.4 percent of total energy and generate 28.3 percent of total carbon emissions; commercial and service establishments consume 17.8 percent energy and generate 17.7 percent of carbon; and all transportation consumes 28.1 percent energy and generates 32.9 percent of carbon.

Energy Consumption by Sector

Households and individuals, at home and in nonbusiness travel, consume 38.0 percent of total energy in the United States, more than the industrial sector alone (32.5 percent), and the commercial/service (17.8 percent) and nonhousehold transportation (11.7 percent) sectors combined. The percentage for households and individuals has increased from 32.4 percent in 2000.
Energy Consumption by End Use

Table 1 to the left shows the estimated percentage of total energy consumed by American individuals and households for different end uses in 2005, divided into travel and in-home sectors. End uses are ranked within the sectors from most to least energy-consuming. The majority of energy is consumed for only two purposes: to run private motor vehicles and to heat and cool homes. Relatively little energy is used for cooking and running computers and dishwashers. This contrast draws immediate attention to private motor vehicles, space conditioning, and a few other end uses like water heating and lighting; households can have the greatest impact by saving energy in these areas, both in terms of overall energy use and in reducing carbon emissions.

Conservation Potential of 27 Different Actions

Table 2 below presents the energy-saving potential of 27 different actions individuals and/or households can take. The actions were drawn from a survey of popular guides mentioned above, including *An Inconvenient Truth*, as well as government Web sites and other scientific and technical sources. Within end uses, conservation actions are ordered from greatest to least conservation potential.

The actions in Table 2 are divided into two general categories. Actions in the left column involve curtailing the use of existing energy equipment, that is, using equipment less frequently or intensively (for example, cutting motor vehicle highway speeds from 70 to 60 miles-per-hour). Actions in the right column involve adopting more energy-efficient equipment or installing or maintaining efficiency-boosting modifications to existing energy equipment (for example, buying a more fuel-efficient motor vehicle and keeping one’s motor vehicle in tune and its tires correctly inflated).

As noted at the bottom of Table 2, the estimates are for individuals or households that have not already taken the actions. Therefore, they should be interpreted as in the following example: If a household now lacks adequate attic insulation, then up to 7 percent of total household energy consumption can be saved by upgrading the attic insulation.

Efficiency versus Curtailment

A comparison of energy saved by curtailing and by increased efficiency in Table 2 reveals that efficiency-improving actions generally save more energy—and reduce carbon emissions more—than curtailing use of intrinsically inefficient equipment. For example, buying and maintaining a highly fuel-efficient vehicle saves more energy than carpooling to work with another person, lowering top highway speeds, consolidating shopping or errand trips, and altering driving habits in an existing gasoline-inefficient motor vehicle. This general finding challenges the belief that energy savings entail curtailment and sacrifice of amenities. Not only is efficiency generally more effective than curtailment, but it has the important psychological advantage of requiring only one or a few actions. Curtailment actions must be repeated continuously over time to achieve their optimal effect, whereas efficiency-boosting actions, taken infrequently or only once, have lasting effects with little need for continuing attention and effort. For example, carpooling requires a separate action for every trip, but replacing a low-fuel economy vehicle with a fuel-efficient one saves energy automatically on every trip. Replacing an inefficient furnace with a highly efficient one saves energy for its useful life, while turning down the thermostat at night requires establishing a new
Most efficiency-increasing actions require a purchase, offsetting their advantage of simplicity, whereas most curtailment actions have no financial cost. Although energy-efficient equipment often provides a good financial return on the initial cost, few people compare the return on energy efficiency with the returns from a savings account or mutual fund. Also, it can be quite difficult for an individual to estimate the return—and even if it is financially attractive, funds are still necessary to make the purchase. Moreover, most people do not keep homes or motor vehicles for their entire useful lives, so they may pay the full cost of efficiency improvements without getting the full return. With rental housing, efficiency improvements must typically be purchased by the owner, while the renter receives the savings. These considerations indicate that there are significant psychological, economic, and institutional barriers to improved energy efficiency that are not present for curtailment. In the current policy context, individuals and households are left to find ways to overcome these barriers. Finally, curtailment and efficiency do not represent an “either-or” choice. In motor vehicle and some in-home energy uses, some curtailment actions can provide significant immediate savings and should not be overlooked. Thus, households can benefit from the most effective actions of both types. Table 3 presents a simple guide for considering both curtailment and efficiency-increasing actions.

### The Short List of Effective Actions

Examination of Table 2 reveals a small number of practical actions individuals and households can take to achieve the greatest savings of energy and carbon emissions. Table 3 below, based on Table 2, prioritizes actions in a few simple categories. It stands in contrast to common laundry lists by providing a short, prioritized, accurate, accessible, and actionable list of the most effective household actions to help limit climate change.
The first nine actions in Table 3 can be taken with little or no initial monetary cost. Six of the actions involve curtailment; three (getting frequent tune-ups, maintaining correct tire pressure, and using CFL bulbs) involve efficiency increases. Individuals or households who can do all nine actions can potentially save up to about one-quarter of their total direct energy consumption and a roughly comparable proportion of carbon emissions. The next eight actions, all involving efficiency increases, generally require greater initial expense than the first nine. Buying one of the Environmental Protection Agency’s top 20 fuel-efficient motor vehicles, or installing or upgrading attic insulation can save more energy than any of the other actions in the table. The eight higher cost, efficiency-increasing actions together can potentially save up to about one-third of total individual/household energy consumption and carbon emissions. Individuals or households who can take all 17 listed actions can potentially cut their consumption and emissions by half.

Table 3 is a guide to priority setting, not a prediction. Although the savings estimates are only approximations, they can help households differentiate between high- and low-impact actions. Readers can consider the first item in each category to be the most energy-saving action possible and give it top priority if it has not already been taken and is possible to take. By going item-by-item down the table, householders are guided to where the greatest potential savings lie for them specifically. The table gives proper attention to relevant efficiency-increasing actions, which are often overlooked by individuals and households and given short shrift in popular guides to action.

It should be emphasized that actual savings may be greater or less than Table 3 indicates. For example, someone who uses more fuel than the average motorist will save more purchasing a more fuel-efficient vehicle than the estimate suggests; someone who uses less fuel than the average motorist will save less. Also, much less potential exists to save energy in households that have already made many of the changes compared with households that have made few or no changes.

How Much Can Households Save?

The sum of savings estimates for the 17 actions—58.2 percent—is an overestimate for several reasons. First, it applies only to households that have not taken any of the actions listed. Second, savings from different actions are connected. For example, the energy saved by caulking and...
weather-stripping a home will be less if a more fuel-efficient furnace is also installed. Third, estimated savings from increased efficiency assume that consumers buy motor vehicles, refrigerators, and furnaces at the end of the old equipment’s useful life. If consumers discard usable equipment, part of the energy they save by using the more efficient equipment is cancelled out by the energy used to manufacture the new equipment. For many households, then, total potential savings are much less than half. Policy analyses suggest that aggregated nationwide adoption of all the actions not yet taken in Table 3 would yield a decrease of about 30 percent in U.S. individual and/or household energy consumption and carbon emissions—still a huge potential.21

A household that wants a more accurate estimate of the energy and carbon-reducing potential of these actions in its unique situation will need a much more detailed analysis. Such an analysis can be provided by an energy audit that includes calculations based on the household’s actual home and one of the household “carbon calculators” now available. However, good energy audits, which are conducted by professional auditors, are expensive, and carbon calculators, in addition to requiring time and effort to complete, are of undetermined and questionable reliability and validity at present.22

What Policy Can Do

Without a concerted national policy effort, individual and household behavior can only go so far. Part of national policy for limiting climate change should make accurate, credible, and actionable information widely available on what households can do to reduce their energy use and carbon footprints. National policy should develop and validate simple guides, such as Table 3, and disseminate them using established communication principles. It should also include making more nuanced, household-specific information widely available—for example, by supporting the provision of credible, convenient, and low-cost household and travel energy audits and carbon calculators. Improvements to existing appliance certification and labeling programs (to compare products in different classes or find the most efficient Energy Star appliances more easily) and new rating and labeling systems for the energy cost of ownership of new homes are also desirable initiatives. Federal, state, and local governments and various nongovernmental organizations can carry out these initiatives. As with current appliance labeling programs, federal agencies can develop and validate information about manufactured equipment and provide for its distribution by businesses to consumers. Local governments and consumer organizations might be best for providing assurance about the quality of private energy auditors and the vendors and installers of household energy technology.

But information alone—even much more useful information than is currently available—is not enough to induce behavior change, especially for many efficiency increases that involve significant initial monetary costs. There are major barriers to change, in addition to knowledge, which must be overcome, even among people who know which actions to take and would like to take them.23 For example, many equipment choices are shaped by intermediaries, such as builders and repair personnel who offer equipment options to households when their attention is focused on other things, such as kitchen design or the need to replace a water heater quickly. Actions like upgrading home insulation and furnace and air-conditioning efficiency can yield major savings, but many households lack the funds needed to make the investments. Renters cannot install such upgrades, and buyers of existing or newly built homes usually cannot choose the efficiency of heating and air-conditioning equipment and insulation. Even when people can afford major efficiency improvements, many may be inhibited by the logistical difficulties of arranging and scheduling the multiple contractors that may be needed to install space-conditioning equipment, insulation, and storm windows and doors. Even low- or no-cost actions compete for people’s limited time and attention.

Many believe that higher energy costs will cause households to economize by investing in energy efficiency. But households historically have not responded to price signals by making anywhere near all the energy-efficiency investments that are economically efficient. A major reason is the cost of information in time and effort required to estimate the actual returns on investment and to find the best products, vendors, lenders, and installers. A large organization can save enough money...
through energy actions to recoup the cost of hiring someone to find the most cost-effective savings opportunities, contract for
the needed work, and ensure its quality. Few households are in this position, and people know it intuitively. Research
conducted during the last U.S. energy crisis in the late 1970s demonstrates that the difficulty and inconvenience of identifying
and taking effective energy-saving steps was a major barrier to action, even when utility companies offered to rebate
households a majority of the cost of major home retrofits.\textsuperscript{24}

Multicomponent programs are needed to encourage energy savings, especially when the initial costs are nontrivial. Education
and information are important, and ideally should include household-specific information, such as professional home energy
audits and energy comparisons for particular choices a consumer is facing. Financial incentives to reduce the initial costs of
upgrading to energy-efficient products are also important, and many creative possibilities exist in this sector, including
incentives targeted to intermediaries; loan subsidies, deferred-payment loans, and rebates for home retrofits; and alterations
in policies for mortgage and auto loans that take into account the energy cost of ownership. Convenience and credibility
enhancements, such as providing free and trustworthy energy audits and lists of approved contractors and help in securing
low-cost financing and inspection of completed work, can be very important for overcoming the nonmonetary barriers to cost-
effective investments in energy efficiency. Programs that offered this sort of one-stop shopping during the energy crisis of the
late 1970s were attractive to households because of these assurances, but these campaigns might have been more successful if
they aggressively marketed themselves and if stronger financial incentives were available.\textsuperscript{25}

A review of home energy retrofit programs from the early 1980s found that financial incentives to reduce up-front costs
motivated more households to retrofit, but the strongest results by far came when incentives were combined with
nonfinancial interventions that strongly marketed the programs and made it convenient for households to take advantage of
the incentives. These nonfinancial features were critical even with the strongest financial incentives, which were offered
under the U.S. Department of Energy’s Bonneville Power Administration’s 20-month Interim Residential Weatherization
Program from 1982–83. Seven participating utility companies in the Pacific Northwest offered an identical package of home
energy audits and financial grants to participating homeowners paying, on average, 93 percent of the cost of recommended
retrofits. Eligible households installed the recommended retrofits at an average rate of 5.3 percent per year, but there was
tremendous variation across the utilities, with rates ranging from 1.4–19.3 percent per year, depending on how a utility
marketed and implemented its version of the program—a difference between getting all the homes retrofitted in about 70
years or 5 years.\textsuperscript{26}

Community-based efforts that use informal social networks to help spread the word—for example, neighborhood cooperation
in a campaign to caulk and weather-strip homes—can make multicomponent programs more effective.\textsuperscript{27} Finally, there is
room for regulatory approaches, such as tightening standards for energy equipment, especially home insulation and water-
heaters where energy efficiency is a major but invisible product attribute.

Rapidly rising prices for oil and other energy products highlight the need for savings for householders and policymakers alike.
But households still do not know what actions best achieve these needed savings, and public policies currently do not provide
the needed support to turn household awareness into effective action. If we apply and build on the lessons of the energy crises
of the 1970s and early 1980s, individuals and policymakers can act more effectively now. For many understandable reasons,
people do not necessarily act in their best financial interest or in ways that yield the greatest environmental benefit—even if
they want to. Achieving change quickly and effectively depends on combining information, incentives, and other policy
approaches with sensitivity to how householders think and the many factors that influence their choices.