

# WHEN ABOVE AVERAGE IS NOT GOOD ENOUGH

Results from a Study of High-Energy-  
Using Homes in Minnesota

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FIGURES BY SEVENTHWAVE

Let's imagine two neighboring families on a residential block—the Joneses and the Smiths. Their homes are of comparable size and age, and both are families of four, living typical middle-class lifestyles. Even they think they're pretty similar, but that's not what the utility company sees. Last year, the Joneses used over 14,000 kWh of electricity and 1,500 therms of gas, while the Smiths used 7,000 kWh and 800 therms, respectively. What's going on in the high-using Jones household? Do they know that they're using twice as much energy as their neighbors are using? Are they content with their usage? What motivates them—and households like them—to take action on their high energy bills, either on their own or through energy efficiency programs?

Some programs have targeted high-energy users because of their greater potential (and realized) savings and the relative ease with which utilities can identify them. Nevertheless, we know surprisingly little about high-energy-using homes and how they differ from other homes.

With that in mind, we set out to understand what causes a home to be a high-energy-using home. Funded by a Conservation and Applied Research and Development (CARD) grant from the state of Minnesota's Department of Commerce, we visited 100 homes throughout Minnesota to conduct a walk-

through audit, a blower door test, and an in-depth interview with the homeowner.

Armed with this information and each home's electric and natural-gas data, we calculated energy savings potential both from the technical side (by implementing measures such as furnace upgrades or air sealing) and from the behavioral side (by implementing measures such as turning down the thermostat or using space heaters less often). We also assessed homeowners' interest in implementing the energy-saving technical measures.

## Opportunities and Causes

We found that high-using households had energy efficiency opportunities similar to those of the population at large. For natural-gas high users, two of the biggest savings opportunities were installing a high-efficiency furnace or boiler and adding insulation to the home. Natural-gas high users could also save considerable energy by setting back the thermostat at night or when no one was home. This could be done either with a programmed setback thermostat or manually.

Space heaters were big electrical-energy hogs, and simply limiting their use would save homeowners a substantial amount of energy. Replacing incandescent lighting with CFLs would also save energy, but we found that many high users don't like

CFLs for various reasons. LEDs were viewed more favorably. We took a look at how much energy could be saved using technical fixes versus energy saved from behavioral changes (see Figure 1).

When determining the causes of high energy use, we found that some causes were structural, while others could be modified to save energy (see Figures 2 and 3). For example, house size is one major contributor to high natural-gas usage, but this

**Technical and Behavioral Opportunities**

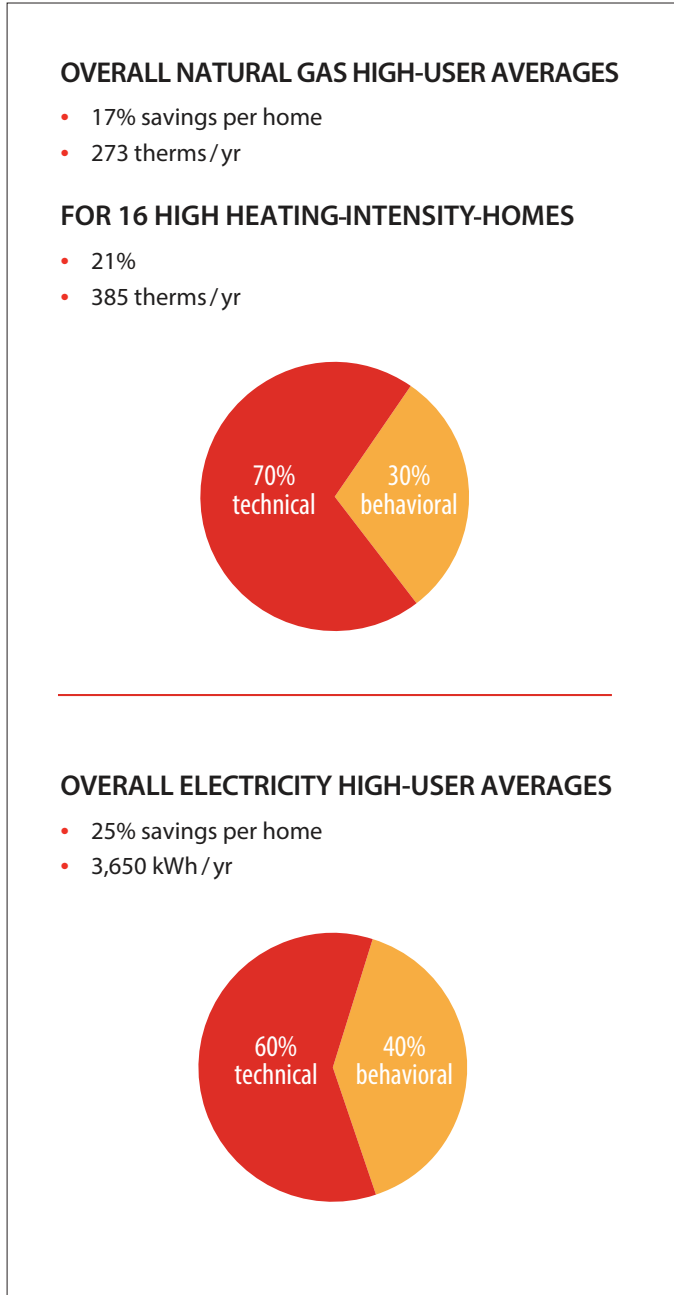


Figure 1. The pie charts show the percentage of energy saved using technical fixes—replace the furnace, upgrade lighting, and so on—and the percentage of total energy saved from behavioral changes—lower the thermostat, reduce or eliminate the use of space heaters, and so on—for both electric and natural-gas high users.

structural cause cannot be modified. On the other hand, an inefficient gas furnace is easily replaced. We further divided the causes of high usage into primary and secondary causes. A *primary cause* is the main driver of high usage in a home; a *secondary cause* is one of several drivers that contribute to high usage.

We also encountered a few eccentric energy hogs. For example, one household we visited had unusually high electricity usage all year long, regardless of the weather. When we arrived at the home, we found that the owner lit up a large flag in the backyard every night with a 2,000W halogen spotlight. Another homeowner kept the dog’s crate warm in the garage using an electric blanket that was on all night in the winter. Yet another owner had four stand-alone freezers in the basement, all over 20 years old. Perhaps the most common energy hogs we found that wouldn’t exist in the average home were hot tubs. And a few homeowners were wasting energy by following bad advice from professionals (see “Building Professionals Beware!”).

**Overview of the Causes of High Usage**

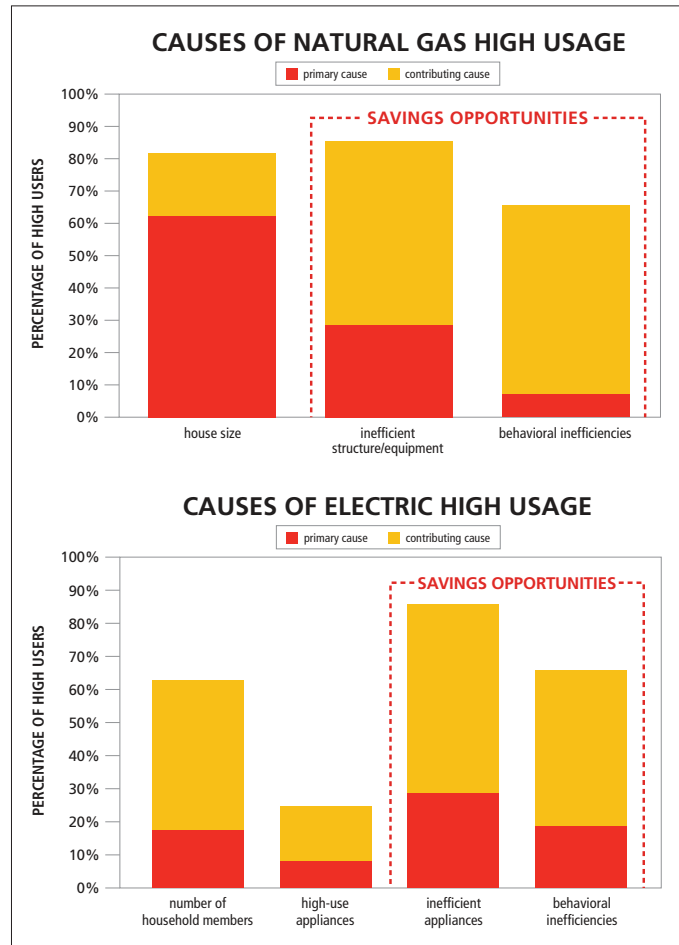


Figure 2. The graph compares the various causes of high usage. Some causes are hard to change (like house size), but other causes can be addressed with energy-saving measures (like replacing inefficient equipment).

## BUILDING PROFESSIONALS BEWARE!

A number of households we visited told us about things that contractors or HVAC installers told them to do that were costing them considerable energy. Many homeowners ran the furnace fan all the time because their HVAC contractor told them to do so. While there may be reasons to run the furnace fan to even out airflow, running it all the time may simply be a waste of fan power. Some families told us that their fireplace installer told them to keep their gas fireplace pilot on, even in the summer. Doing so not only wastes natural gas but may also increase the cooling load.

## Are They Happy High Users?

There weren't many surprises in the high users' consumption patterns, or in their energy-saving opportunities. For the most part, we saw typical households living in typical homes, using energy in standard ways, just using more of it. But that meant more saving opportunities. Energy efficiency professionals would know what to do here, but would these households be interested? Or are the Joneses content with their high-using ways?

The good news for energy efficiency advocates is that the households we visited did seem interested. They took an active interest right from the start, when we called to recruit them into "an energy study." Roughly half of the homes we reached agreed to participate; ears perked up at the thought of a free energy audit. To be paid for participation was just icing on the cake. Participants were also highly engaged and candid when we discussed their audit results and their energy-saving opportunities.

These households were not happy high users, nor were they content to let their bills add up. Ninety-three of the hundred homes had made past efforts—sometimes many efforts—to reduce their usage. They had bought Energy Star appliances,

added insulation, replaced lightbulbs, and so forth. When utilities and media presented the usual energy-saving tips, the high users paid as much attention as everyone else.

## Do They Even Know?

Some high users suspected that we had selected them for the study because they were high users; others had no idea that they used more energy than their neighbors. How would they know? Some utilities do send their customers comparative information, but customers tend to react skeptically. They suspect that the comparisons aren't valid (see "What Else Can I Do?"). Still, there seems to be something about being outed as a high user that catches people's attention and makes them think. If the comparison itself isn't suspect, it is an effective way to communicate that the household could be doing better.

## Overcoming the Informational Barriers

High users have unrealized efficiency opportunities that professionals and programs can help to overcome. The first is that while high users may have done some of the obvious things, they—like most people—don't really know what to do next. Generic tips don't help much here, because they don't tell high users anything about their particular homes.

Home energy audits may be a solution, but it's hard to get homeowners to bother with an audit of their homes. Some Minnesota utilities have had success with a more proactive outreach, as we did in recruiting participants into our study. However, there may be other, intermediate solutions—ones that are easier and cost less than an audit but that are more specific to a particular home than the ubiquitous 101 tips to save energy that people sometimes get in bill stuffers.

For a second phase of the CARD-funded study, we are developing solutions to help energy efficiency programs address saving opportunities among high users. One option we are in-

## Aggregate Natural Gas-Saving Opportunities

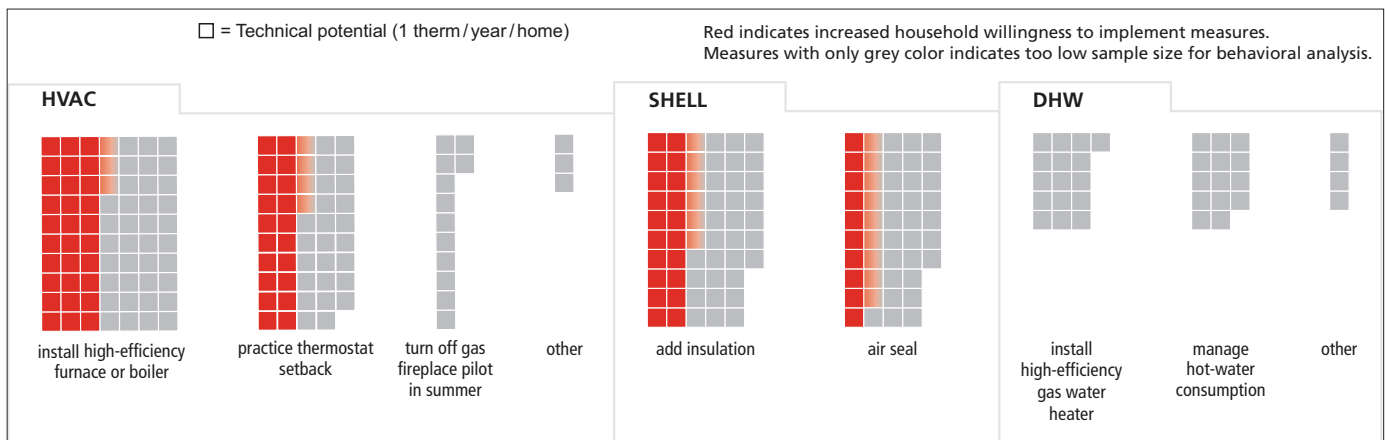


Figure 3. Potential natural gas-saving opportunities shown with the results of an analysis of household willingness to implement measures. The final report—expected in mid-2016—will have a similar overview of electric saving opportunities.

## High Users in Minnesota Overestimate Their Energy Bills

### WHAT ELSE CAN I DO?

“My utility tells me that I use more energy than my neighbor. But my neighbor is different from me—it’s just him and his wife, and we have three kids! And I’ve done most of the energy-saving tips they told me to do. What else can I do?”

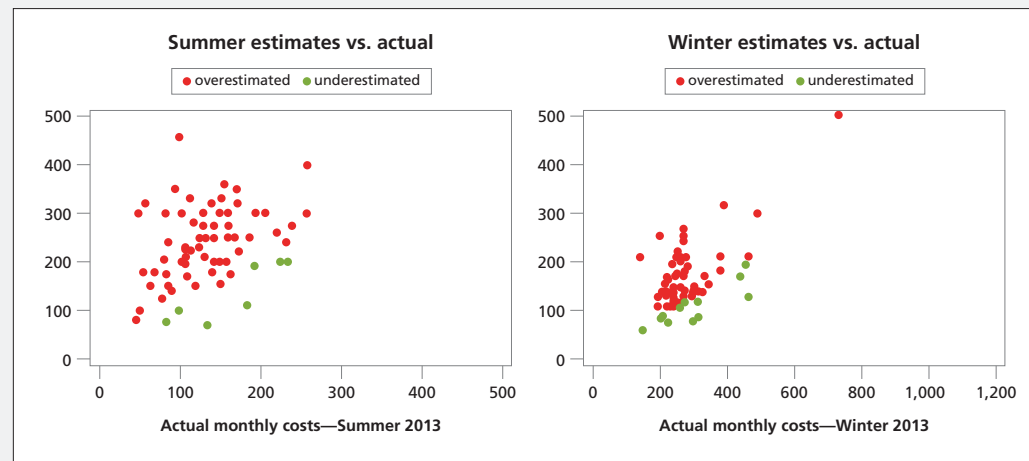


Figure A. Study participants consistently overestimated the amount they were paying for utility bills.

investigating is the potential role of remote audits. As the energy industry gains greater access to high-resolution consumption data, it is increasingly able to offer well-informed guesses on what is ailing homes. In fact, we prescreened the consumption patterns of the high-using homes we were going to visit to identify the opportunities we would find during the audit. More often than not, our predictions were on target. Remote analytics offer opportunities to engage high users with home-specific information without the cost, in time and money, of an audit, or at least to motivate them to conduct an audit.

Another option is to create a set of half a dozen (not 101!) energy-saving tips designed specifically for high users. Most of the energy-saving opportunities in high-using homes came

from implementing just a handful of measures. These included upgrading the heating system, adding insulation, and turning off electric space heaters. Focusing on just those few measures as key opportunities “for customers like you” would point customers to solutions that would help them save energy.

There are also some misperceptions among high users that must be addressed. As noted, their use of portable space heaters was high. In some cases, this was because the home was not served well by the primary heating system. In other cases, people said they wanted to keep the overall house temperature lower by heating individual rooms. Interestingly, though, study participants seemed to dismiss the cost and energy use of plug-in space heaters. Some volunteered that they bought a particularly energy-efficient model (all-electric-resistance space heaters are 100% efficient at turning site energy into heat); others dismissed the cost as being “pennies a day.” Yet we found that the energy-saving potential of reducing the use of portable space heaters was about two-thirds as much as that of replacing inefficient main heating systems. People are using those little bundles of warmth extensively and are underestimating their impact on the monthly bill. We see an educational opportunity here.

### Information and Rebates Alone Aren’t Enough

All too often, energy efficiency programs provide energy-saving suggestions and highlight rebate offers, but after getting this information homeowners are left to go back to their everyday lives. Replacing lightbulbs is easy enough, but bigger opportunities are hard to implement. Even for the well intentioned, it takes additional effort to weigh the costs and benefits of different energy saving measures, navigate the market for contractors, choose among the options presented, and proceed with larger projects. It’s easy



BEN NAUGHTER



JEANNETTE LEZANS

Left, old freezers and refrigerators can use a lot of electrical energy, especially if they are secondary units that are not fully utilized and are mostly empty. Right, heating upgrades offer a good return on investment, especially if equipment is older.



INGO BENSCHE

One of the authors in the field, examining an air-conditioning unit to characterize the energy use in this home.

for good intentions to get deferred among all the other business of life, as happened with one of the authors of this article, who needed ten years after the energy audit to get that insulation project done.

Again, these barriers aren't all that different for high users than for other people, but helping high users to overcome those barriers may lead to greater energy sav-

ings. Follow-through requires not just information but an ongoing relationship of assistance between high users and utility or efficiency program staff and contractors, so good intentions are not forgotten and high users aren't overwhelmed by the challenges of navigating a project.

In working with some partner utilities in Minnesota, we have explored such possibilities as additional targeted follow-ups after audits to remind households of their opportunities. We have discussed the possibility of having households state their explicit intentions and set their own priorities among the audit recommendations. Utility staff can then remind them of these intentions later. We have even contemplated providing a high-user hotline that provides technical and logistical support to households that are interested in taking the next step but need some hand-holding. A public report on the CARD-funded study, to be released in 2016, will highlight conceptual and practical approaches that energy efficiency programs and utilities can take to help high users save some of those excess kilowatt-hours and therms.

## Addressing the Mobile Society

There is one barrier to conserving energy for which we have no good solutions. We live in a mobile society in which households move, on average, every seven to ten years. Those future moves—even in the absence of any specific plans—appear to be on people's minds when they weigh just how much they want to invest in their current home. "I might move in five years" was a common comment we heard when we inquired about energy-saving measures that would require a large investment. Some older participants were aware that their "book was closing," and that they might not live to reap the benefits of any big financial investment that they made in the home. We could use better mechanisms to ensure that any energy efficiency upgrade actually adds to the value of the house.

"I've lived in this house for over 30 years. I'm done doing big projects. I don't want to make an investment now because I'm getting older and frankly, I don't think I'll live to see the benefit. I'll let the next owner do that."

– Research study participant

It has been fascinating to explore the world of high users and to find, not McMansions of happy high spenders, but a mirror reflecting many of the same technical opportunities, interests and concerns, and motivations that we are used to dealing with in the residential population at large. Still, these homes warrant more effort on the part of energy efficiency programs because they represent a higher saving potential. Our study focused on Minnesota, but there are high-user homes in all states and provinces. Focusing more effort on the Joneses in our neighborhoods may well be an effective strategy for maximizing the impact of energy efficiency efforts in the residential sector. It all starts with distinguishing the Joneses from the Smiths.

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### >> learn more

You can watch the free January 2015 webinar on the High-Energy-Using Homes study here: [www.seventhwave.org/education/webinars/residential-high-energy-users](http://www.seventhwave.org/education/webinars/residential-high-energy-users)

Check out the Minnesota Department of Commerce website to find out more about the Conservation and Applied Research Development Grant: <http://mn.gov/commerce/energy/utilities/conservation/Applied-Research-Development/>