TESTIMONY OF MS. ANITA EIDE

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REGARDING COMPARATIVE ELECTRIC UTILITY BILLING INFORMATION

Subcontract for the
Helios Centre for Sustainable Energy Strategies

Part of the submission of the
Regroupement national des Conseils régionaux de l'environnement du Québec

Before the Régie de l'énergie's
Docket R-3439-2000

November 24th, 2000

Please describe your qualifications.

I am currently pursuing a Ph.D. in Urban Affairs and Public Policy at the University of Delaware, where I am affiliated with the Center for Energy and Environmental Policy (CEEP). I am Norwegian and my doctoral dissertation investigates Norwegian energy policy with a focus on residential energy efficiency policy and energy information measures.

Prior to joining the University of Delaware I received a Masters in Environmental Studies, with a concentration in Environmental Policy, and a Bachelors in Marketing and Economics, both from the University of Strathclyde in Glasgow, Scotland.

While at CEEP, I have worked as policy analyst and research associate on two major energy information projects: 1) The Energy Star Billing program, a pilot innovative billing information project funded by the U.S. Environmental Protection Agency (EPA)[1] and 2) The National Information Infrastructure Project. [2] Under a U.S. Department of Energy contract, we co-operated with Dr. Charles Goldman at the Lawrence Berkeley National Laboratory in California, to assess and evaluate consumer interest in communications-based energy information services. On both projects I worked under Dr. Willett Kempton, Senior Research Scientist at the CEEP.

Prior to working with Dr. Kempton, I was a research associate at the CEEP on contract with the Delaware General Assembly – providing technical assistance on the formulation of viable growth management policies for the State of Delaware, as well as with the Delaware Office of Public Advocate, providing technical assistance on questions concerning public utility deregulation and possible impacts on consumers, and preparing evidence presented in dockets before the Delaware Public Services Commission.

In 1997 I received a doctoral fellowship from the Norwegian Research Council to investigate energy information measures and electric utility billing information in Norway, in particular. I joined Dr. Hal Wilhite's billing feedback project group the same year. I participated in focus group research and in numerous meetings during the development and experimental testing of the project's comparative graphic displays, in particular normative feedback and disaggregation of end use. Furthermore, I also acted as liaison between the project groups in Norway and the US. Though there are differences both in approach and results, both projects have benefited from an exchange of information and experiences.

A complete list of references providing detail about both projects, the evaluations and background can be found at the end of this document. I have also included a list of my most relevant publications from the projects mentioned above in Appendix G.

What is the background and rationale for your programs?

The improved billing information discussed here is particularly important for two reasons: First, to make households aware of their energy use – providing a better platform for energy

[1] The research discussed here was funded in part by the United States Environmental Protection Agency (EPA) under co-operative agreement CX 8244452-01 to the University of Delaware.
[2] This project was funded by the Norwegian Water and Power Authority (NVE), Oslo Energi and Stavanger Energi (now Lyse Energi)

savings – and second, to improve communications between the utility and the energy consumer. Furthermore, the comparative billing component provides individualised energy information for a mass-audience, at very low cost, using an already existing, but often under-utilised, communications channel – the utility bill. Prior studies also show that the more specific and relevant the energy information is to the household the more effective it is in achieving energy savings (Schipper, 1987).

Research on energy conservation in family households shows that per-household savings up to 30% can be realised through consumer behaviour changes alone (Seligman and Darley, 1977; Geller et al. 1982). The provision of feedback information is a non-coercive, non-intrusive policy for tapping part of this potential. Findings from earlier billing projects introducing historical self-comparisons implemented in Norway and Finland support this finding.

The studies I participated in had as their main goal to develop billing information that addressed the problems identified in these earlier studies. The information had to meet consumer needs and preferences and provide information that was analytically sound and easy to comprehend, so as to allow for well-informed decisions about energy use and conservation efforts. Both programs were developed in cooperation with utilities and developers of utility software and, as such, are relatively easy to implement within existing utility billings systems and equipment.

Both projects were motivated by prior research efforts that found existing utility bills to be deficient in a number of ways. Billing information is often poorly understood and interpreted by consumers and does not address the information needs of many bill payers (Kempton and Layne 1994). Evidence from several studies carried out by Kempton et al. shows that consumers use billing information, often extensively, but make invalid inferences about conservation measures based on existing data given on the bill (Kempton and Layne, 1994).

These earlier studies also show that residential utility customers value accurate and easy-to-understand information about their energy use and would like to receive more informative billing information, a finding that has been substantiated in all the energy billing studies that we have done. Kempton (1995) found that customers want their utility to provide them with simple, straightforward information that addresses the specific situations of their own home, making the case for household specific rather than general information relying on utility averages.

Kempton and Montgomery further found that because energy services (heat, light, etc.) are billed in the aggregate and in unfamiliar units of kilowatt hours (kWh), consumers have no easy mechanisms for learning about their home's energy use (1982) making the case for disaggregated billing information. With aggregate energy billing energy conservers receive no clear signal about the savings associated with prior actions, making evaluation of efficiency measures very difficult.

What characterises the comparative energy information and on what basis are comparisons made?

Our studies are concerned with feedback that shows each customer how their billed energy use compares to that of others in "houses like yours." It is a comparative performance

measure and works only in those cases where the consumer is able to recognise the relationship between behaviour and outcome.

In the Stavanger Energi study[3] we also tested information disaggregated end use. By disaggregation, we mean making visible for the energy consumer how much energy goes to important end uses in the dwelling. Since typically individual end-uses are not metered, there are widespread misconceptions about how much energy goes where. Several studies have found that a common misconception is that more energy goes to lighting and cooking (visible) than actually does, and less to space heating and cooling (invisible) (Kempton and Montgomery 1982; Wilhite 1984; Wilhite et al. 1996). The objective of disaggregation is to correct misunderstandings and raise awareness about the contribution of important end uses like space heat and hot water.

The U.S. study[4] used a "neighbourhood comparison" approach, the comparison group being all of the households in a given neighbourhood, combined with house size and appliance mix. In the Norwegian study (covering Stavanger and Oslo), it was decided to place recipients into groups of similar households drawn from the entire greater metropolitan area. The categories used were: number of people in the household, type of dwelling, house size, use of electric heating (three categories: 100% electric, mix of electric and other, no electric), and hot water either included or excluded from the household electricity bill (a situation particular to multi-household dwellings)

Neighbourhood comparisons can also be based on addresses, postal codes or meter read routes. This eliminates any data costs associated with collecting house data and encourages informal discussions among neighbours who receive the comparative feedback.

Please describe the projects and the research work conducted in the U.S.

The research work we did in the U.S. falls into tree categories and occurred at several stages. The first stage involved face-to-face interviews and a mail survey. During the second stage, we did face-to-face interviews with customers in the Traer municipal utility's service territory, after they had received the billing graphic for two months. We then proceeded with face-to-face interviews with customers in both Traer and Amana (another participating municipal utility) after the utilities had provided the information on the bill for 3 years and 1 year, respectively. At this point we also carried out a mail survey of the entire customer base in both utilities. Since our project culminated in the implementation of a comparative graph by the two Mid-Western utilities, we mostly concentrate on the evaluation results of the program, but also include some of the main findings from the first mail survey that tested preference and comprehension of the initial four graphic displays.

Please describe the projects and the research work conducted in Norway

The decision to explore normative feedback and disaggregation of end use in Norway, came as a result of very positive results from implementation of historical feedback by *Stavanger*

[3] This study evaluated the effects of normative (comparative) feedback and disagregated end-use information provided.

[4] This study evaluated the effects of comparative feedback provided in the Traer and Amana municipal utility service territories.

Energi. In fact, Stavanger's success with the program, that has reported electricity savings of 8%, lead NVE to introduce legislation mandating that all utilities provide this type of information to their customers as of July 1, 1999. Denmark has gone one step further and has decided that all utilities have to implement both historical and normative (i.e. comparative) feedback on their bills.

In Norway, 3 displays were tested in a total of 6 focus groups in Oslo and Stavanger. Three types of displays were chosen to visualise the comparison: a linear version which placed the recipient's consumption in relation to the highest and lowest energy consumers in the group; a normal (bell) curve version which shows not only the placement, but the distribution of households within the group; and a variation on the normal curve, in which the shape of the curve is represented with figures of small houses. The latter is similar to the display preferred in the U.S. Study.

The linear version and the normal curve version, but not the small house version, were then tested using a mail survey with a larger sample. Examples of the final versions of the linear and normal curve representations which were used in the test are presented here as Appendices E and F. A questionnaire was sent to 2000 households, 1000 in Oslo and 1000 in Stavanger. Findings were similar in both cities (for simplicity, I will discuss only the Stavanger findings in my testimony).

In Norway, disaggregated end use information was also explored. By testing in focus groups we found that the pie chart version was overwhelmingly favoured in all of the groups over the bar chart. The pie chart (see Appendix F) was considered to be easier to interpret and to give an easier overview of the disaggregation. Similarily, based on tests in the same focus groups and on the limitations on questionnaire length and programming, we selected six end uses to be included in the display: electric space heating, other space heating, hot water, light, "white appliances" (in Norway these are kitchen appliances and washing machine), and "other".

In the U.S. examples you have worked on, were customers able to comprehend in a meaningful way the information provided?

Our program evaluation of both the Traer and Amana programs shows that only 4% of respondents said they could not understand the graph. Those who said they did not understand the graph were significantly older, average 67 years, versus 54 years for those who were able to properly interpret it. More customers at Traer correctly understood the graph – perhaps because at the time of the evaluation it had been a component of Traer's bill for three years, versus only a year at Amana. For those who made the comparison, the respondents' actual position on the graph was used to verify comprehension.

The following table indicates the evaluation results.

Graph Comprehension: Ability to make comparison	**Percentage of non-missing**
Graph too difficult to understand	4%
Not enough information	10%
Did not answer, missing	N/A
Made comparison (Lower, same, or higher bill)	83%

The results of the initial mail survey, that tested the four graphical displays in Appendix A, show that 67% of respondents understood and interpreted the graphs correctly. The distribution graph with houses was preferred over the other three displays, and understood by 79% of respondents.

What about customer comprehension of the information in Norway?

Our study of customer comprehension in Norway found that only 16% of respondents found that the normal curve was difficult to understand, while 77% found the contrary. This is a remarkable result, given the sophistication of the normal curve.

The results of the linear graph reveal that it is widely understood, and comparatively speaking, fewer had problems understanding it than did the normal curve. Only 9% found it difficult to understand and 83% disagreed with this statement. Looking at the demographic subgroups, the only group that had greater problems than the average was those over 60 years old. Even there, only 29% of this subgroup found the normal curve difficult to understand. None of the subgroups had greater than average problems with the linear graph.

The following table illustrates the results of the 'ability to comprehend' research.

Stavanger: "The figure was too difficult to understand"	**Normal curve**	**Linear**
Agree/completely agree	16%	9%
Unsure/Don't know	8%	6%
Disagree/Completely disagree	77%	83%

Again, the results for disaggregation are also convincing. Very few had trouble with comprehension. There were two groups which were somewhat weaker than the norm, those whose age was over 60 years old and those who had 9 years or less of education. In both groups, about 19% found the figure difficult to understand.

Stavanger: "The figure is difficult to understand"	**Disaggregated**
Agree/completely agree	7%
Unsure/Don't know	5%
Disagree/Completely disagree	89%

In the U.S. examples, did customers appreciate the information provided?

The U.S. evaluation data indicates that respondents greatly appreciate the program's comparative billing information; that the majority comprehends it; and that it leads them to say that they have, or would, adopt energy conservation measures.

In fact, comparative billing is seen as having sufficient value that it actually affects the rated overall quality of service of the utility, as well as the likelihood, if this option were to exist, of switching utilities. According to our evaluation, those receiving the graph rated utility service above those who did not, and the difference was highly significant at the $p<.0001$ level (pooled t–test = 70, 554 df, $p < 0.0001$). Also, 17% said they would switch utilities to receive

the graph, even if the were satisfied with their current utility. These data indicate strong appreciation for the type of information provided.

Furthermore, 64% said they have made energy efficiency changes as a result of receiving the comparative graph and an overlapping 40% expressed their intention to do so.

Are results in terms of customer satisfaction and appreciation similar in the Norway projects you worked on?

Yes. In Norway, Stavanger's experiences reveal that each of these various forms of comparative feedback information – comparison with others and disaggregation of energy end uses – are highly valued by customers and in addition have the effect of increasing awareness and knowledge about energy use.

In fact, only a very small proportion of recipients found it to be useless or uninteresting. Virtually the entire sample, 94% and 98%, was interested in receiving the normal curve and the linear curve should it be offered in the future. 88% thought the information in the normal curve was useful.

Stavanger: Level of interest	**Normal curve**	**Linear**
Agree/completely agree: The information is useful	88%	83%
Disaggree/completely disaggree: The information is not interesting	85%	88%
I am interested in receiving the information should it be offered	94%	98%

The customer evaluations in Stavanger give a number of strong indications that the disaggregation is an information measure people are very interested in and that it has the desired pedagogical effects. 81% found the information to be very useful. And the fact that an impressive 95% was interested in receiving the information in the future is in itself an extremely positive evaluation. Respondents were about equally divided on whether they would like to have the information with every bill, or only once a year. In response to a question on whether people would be interested in getting the information by internet, 20% responded yes. Based on the positive results in evaluating these comparative energy information measures, Lyse Energi[5] is currently exploring the possibilities of offering a web-based version.

What do we know about the ability of this type of information to help customers improve energy efficiency and reduce their energy bills?

The U.S. evaluations of the graph in Traer and Amana shows that a very high proportion of customers report that they have taken energy efficiency actions (64%), and an overlapping but also high percentage saying they plan to do so (40%). Although 34% of the customers reported "The graph did not cause us to want to do anything," this must be framed by looking at their additional comments written in a "Comments" section of the survey. Many of these customers reported that they had already taken actions to lower their energy use before they

[5] Stevenger Energi recently merged with several other utilities. Lyse Energi is the name of the new utility.

saw this graph, and the graph only reinforced and informed them to keep doing what they had been doing.

Actions taken following receipt of graph	Percentage
Have already taken one or more actions (mean = 1.6 actions)	64%
Plan to take action (improve house or buy efficient appliances)	40%
No action stimulated by graph	34%
Wanted to act, but did not know what to do	5%

Below follows a list of the specific actions respondents reported having taken, or plan to take.

Reported actions	Percentage of Valid Answers
Called Utility	5%
Asked Utility How to Lower Bill	1%
Discussed Graph Within House	19%
Discussed Graph With Neighbor	6%
Changed Habits	25%
Chose Low-Energy Appliance	21%
House Improvements	13%
Plan to Buy Low-Energy Appliance	27%
Other Changes	3%

What about energy savings results in Norway?

We found that providing comparative information increases consumers' knowledge about their own energy use and raises awareness as to the existing energy efficiency or savings potential. The numbers in the two tables below illustrate this assertion. With both versions, somewhere between 35% and 51% of the respondents were surprised at their placement with respect to others and around one third found their relative electricity use to be higher than they had assumed. Thus the feedback had the desired effect of correcting misconceptions and raising awareness for a large portion of the respondents.

Stavanger: "I'm surprised by how the amount of my electricity consumption compares with others"	Normal curve	Linear
Agree/completely agree	35%	51%
Unsure/Don't know	32%	24%
Disagree/Completely disagree	22%	24%

Stavanger: "The placement of my electricity was further to the right in the diagram than I would have believed"	Normal curve	Linear
Agree/completely agree	29%	39%
Unsure/Don't know	28%	22%
Disagree/Completely disagree	42%	38%

Following on this, about three fourths of the Norwegian respondents said they would be motivated to reduce their electricity use if they were using more than the average household in their comparison group. Since about half have electricity consumption higher than average, one could deduce that 36% of the respondents who received the normal curve and 38% who received the linear graph would be motivated by the feedback to save energy.

Stavanger: "If my electricity consumption were higher than the average, it would motivate me to save energy"	Normal curve	Linear
Agree/completely agree	72%	77%
Unsure/Don't know	15%	16%
Disagree/Completely disagree	11%	6%

In sum, normative (i.e. comparative) feedback has received high marks when it comes to customer interest, and it clearly has the desired effects of increasing awareness and acting as an incentive to reduce energy use.

We also found that 84% thought the disaggregated information gave them a better understanding of their household's electricity use, while 81% acknowledged that the display provided them with knowledge about their energy use that they did not get through other information. Another 84% said that seeing the disaggregation of end uses had led them to better understand their energy use.

38% had misconceptions about the breakdown of their electricity use, saying that the various categories were different from what they previously believed, and 34% were unsure, suggesting that they were uncertain beforehand. These responses indicate that the disaggregation has had its desired effect for a significant proportion of the sample.

A subsequent study carried out in Finland that provided bimonthly disaggregated information along with energy information comparing the household consumption of the participants in the study to that of others in Finland and to the other households participating in the study, further reported decreases in electricity consumption after monitoring and feedback of 17-21% (Haakana et al. 1997).

Could you qualify the costs of these programmes relative to their benefits?

Because the program implemented in Norway was an experimental one, we do not have full data on costs of implementation. However we do know that benefits are considerable: increased customer satisfaction, more informed customers, and potentially large utility-wide energy savings – providing benefits to utilities, individual consumers and society.

As for actual energy savings, the results from Traer and Amana are impressive. For example, even if only a fraction of the 21% who said they bought more efficient appliances – and the 27% who said they plan to – actually did so as a result of the comparative billing graph, as they claim, this alone would likely justify the cost of the program implementation many times over.

Regarding implementation, both Traer and Amana reported that cost of program implementation was low; the inclusion of the comparative graph did not generate additional load on customer service; and ongoing costs were negligible.

We know from evaluation of experimental implementation of similar programs, that the billing innovations we have developed and, in the case of Traer and Amana, implemented can reasonably be expected to produce energy savings that are small (0.5%-2%) but highly cost-effective (roughly 0.5-2¢/kWh). This represents a savings of approximately $5-$20 per participating household.

Are there any substantive reasons to believe that results would be markably different in Hydro-Québec's service territory?

No. While Hydro-Québec is significantly larger than the utilities we evaluated, there is no reason for this to affect the results, in terms both of savings and unit costs (if anything, unit costs would likely be lower). Furthermore, the peculiarities of Hydro-Québec's system – its climate, its generation mix and the unusually high market penetration of electric space heating – are mirrored by the Norwegian examples. Finally, I am not aware of any reason for which Québec consumers would be less educated or less able to comprehend and appreciate the information provided in comparative billing than were customers in Norway or the U.S.

Does this conclude your testimony?

Yes it does.

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Appendix A

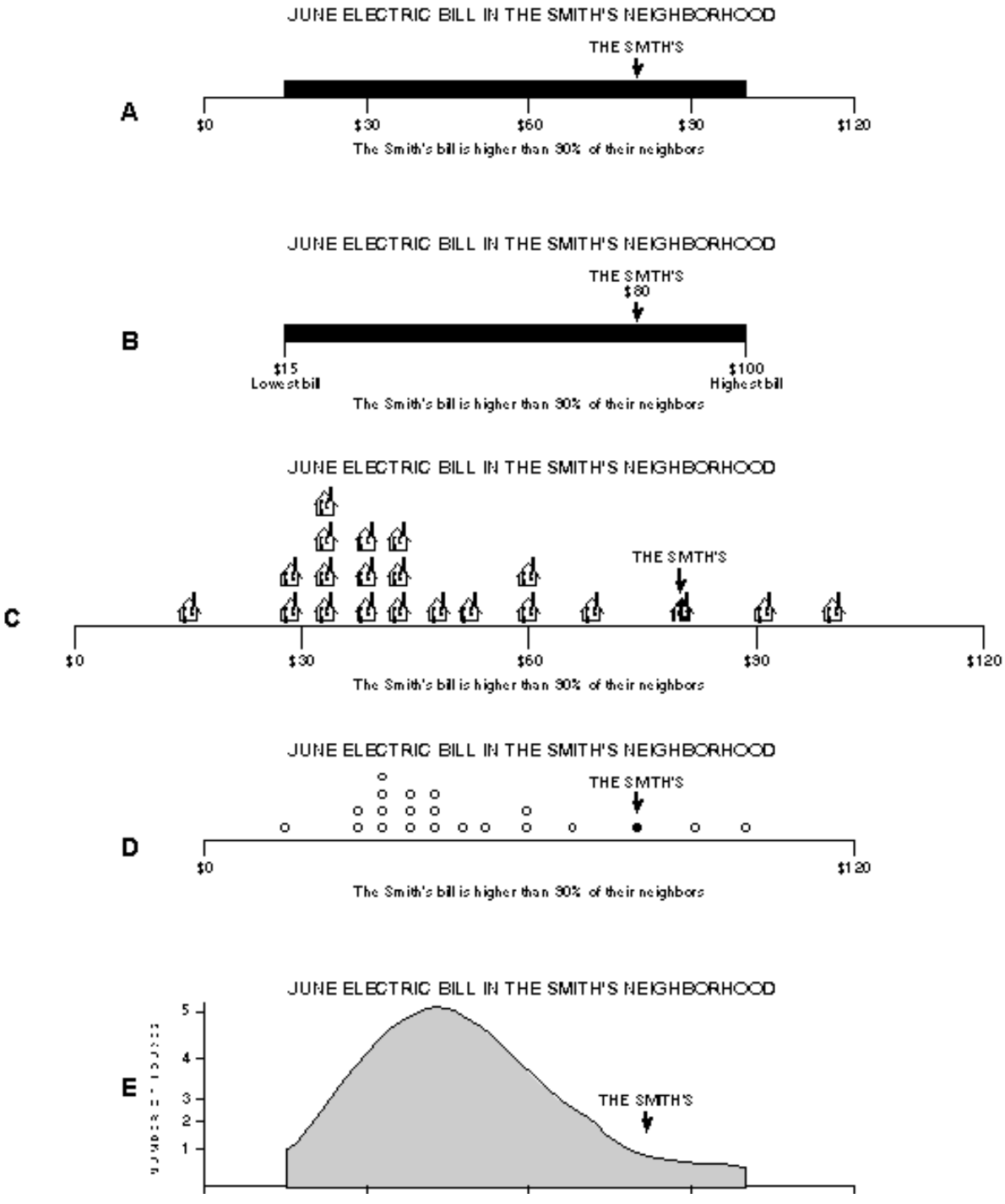

Figure 1. We tested the graphs in displays A, B, C and D in a mail survey of 600 Delaware residents.

Appendix B

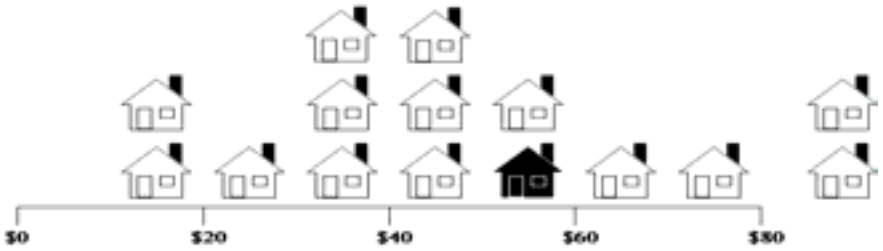

Figure 2. Sample distribution graph with houses, developed for the US study

The graph in figure 2 is the primary bill option that emerged as a result of the extensive consumer testing described above. It is a monthly distribution graphic comparing the customer to "houses like yours," with "houses like yours" represented by house icons along a line of monthly bill expenses, stacking representing more houses at that monthly expense level, and a darkened house representing the recipient's own bill that month. (The two houses shown off the right edge of the graph are outliers.)

```
Comparing 0-1016 sqft homes
Ht: G   Wth: G   Dry: G   Oven: G   AC: Y
X = your electric bill: $111.06
   +-----+-----+-----+---X-+
$7                        $122
```

Figure 3. Character-only bar graph implemented in Traer and Amana utilities due to limited graphic capabilities in billing system

Appendix C

TRAER MUNICIPAL UTILITIES
649 2nd STREET
TRAER, IOWA 50675

SERVICE ADDRESS: SERVICE ADDRESS

ACCOUNT NAME
ACCOUNT ADDRESS
STATE, ZIP CODE

BANK NAME	
BANK ACCOUNT	
ACCOUNT NO.	887 5 3516
AMOUNT DUE NOW	171.29
AFTER	09/20/98
PAY THIS AMOUNT $	172.96
AMOUNT ENCLOSED	

RETURN TOP PORTION WITH YOUR PAYMENT TO INSURE PROPER CREDIT TO YOUR ACCOUNT

EXP | ACCOUNT NAME / ACCOUNT ADDRESS | ACCOUNT NO. 887 5 3516 | READING DATES PREVIOUS 07/15 PRESENT 08/20

METER READINGS PRESENT	PREVIOUS	MULT	AMOUNT USED	CODE	AMOUNT
29996	28504	1.0	1492	RES	105.66
				FFA	5.40
				SEW	8.83
403700	398400	1.0	5300	WAT	34.86
				GAR	9.25

Comparing 0-1016 sqft homes
Ht:G Wth:G Dry:G Ovn:G AC:Y
X = your electric bill: $111.06
+-----+-----+-----+---X-+
$7 $122

TX	7.29
AMOUNT DUE NOW	171.29
AFTER	09/20/98
PAY THIS AMOUNT	172.96

TRAER MUNICIPAL UTILITIES (319) 478-8750

Figure 4. Sample Traer bill

Appendix D

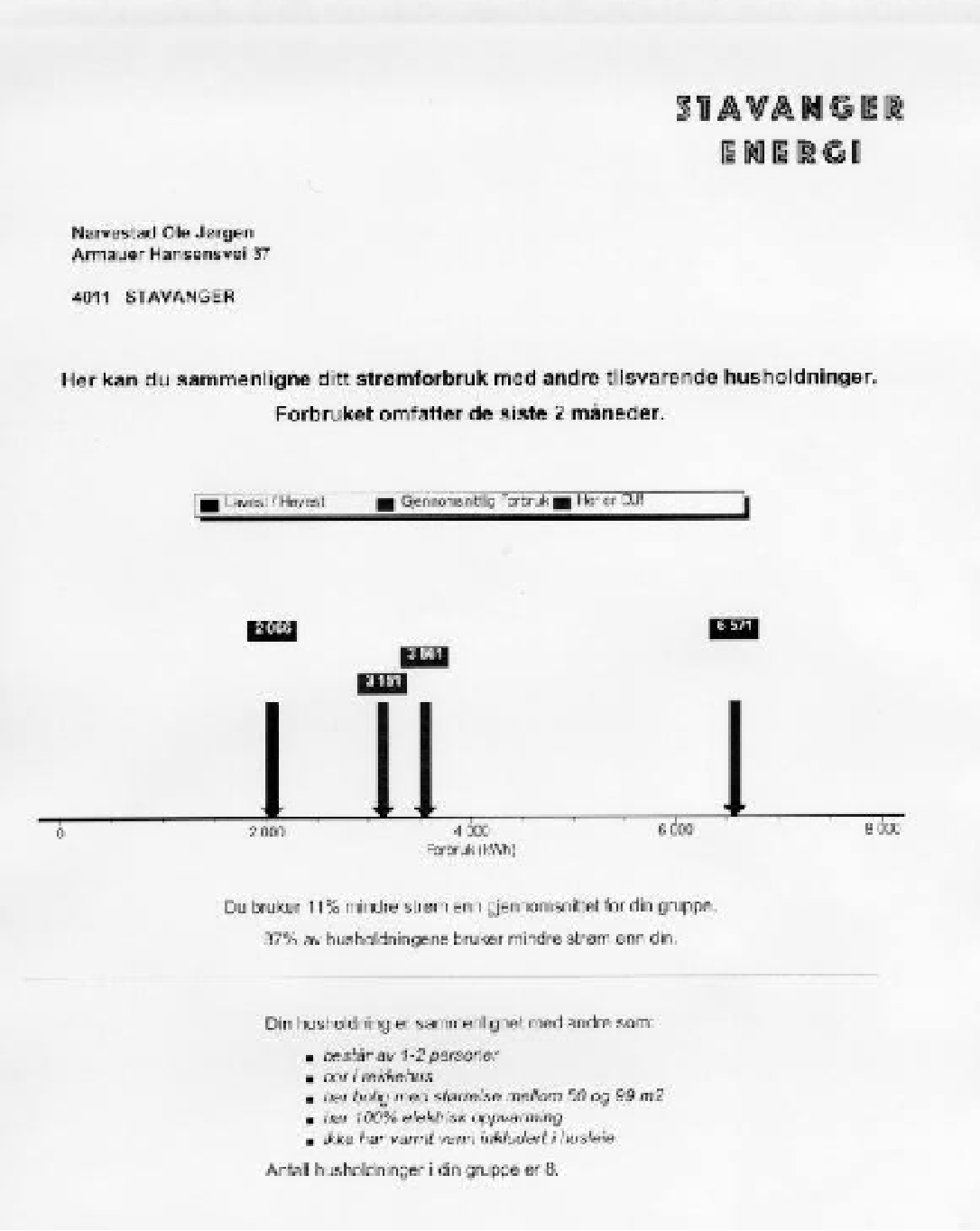

Figure 5: Linear graph tested in Stavanger Energi study of normative feedback. The graph shows the household's electricity consumption relative to other households with same number of occupants, same type of dwelling, similar floor space, all electric, and with consumption of hot water not included in rent. The graph shows highest, lowest and average consumption and "you are here." Under the graph there is a message saying that "You use 11% less electricity than the average in your comparison group." and "37% of households use less electricity than yours." Also, it gives the total number of households in your comparison group.

Appendix E

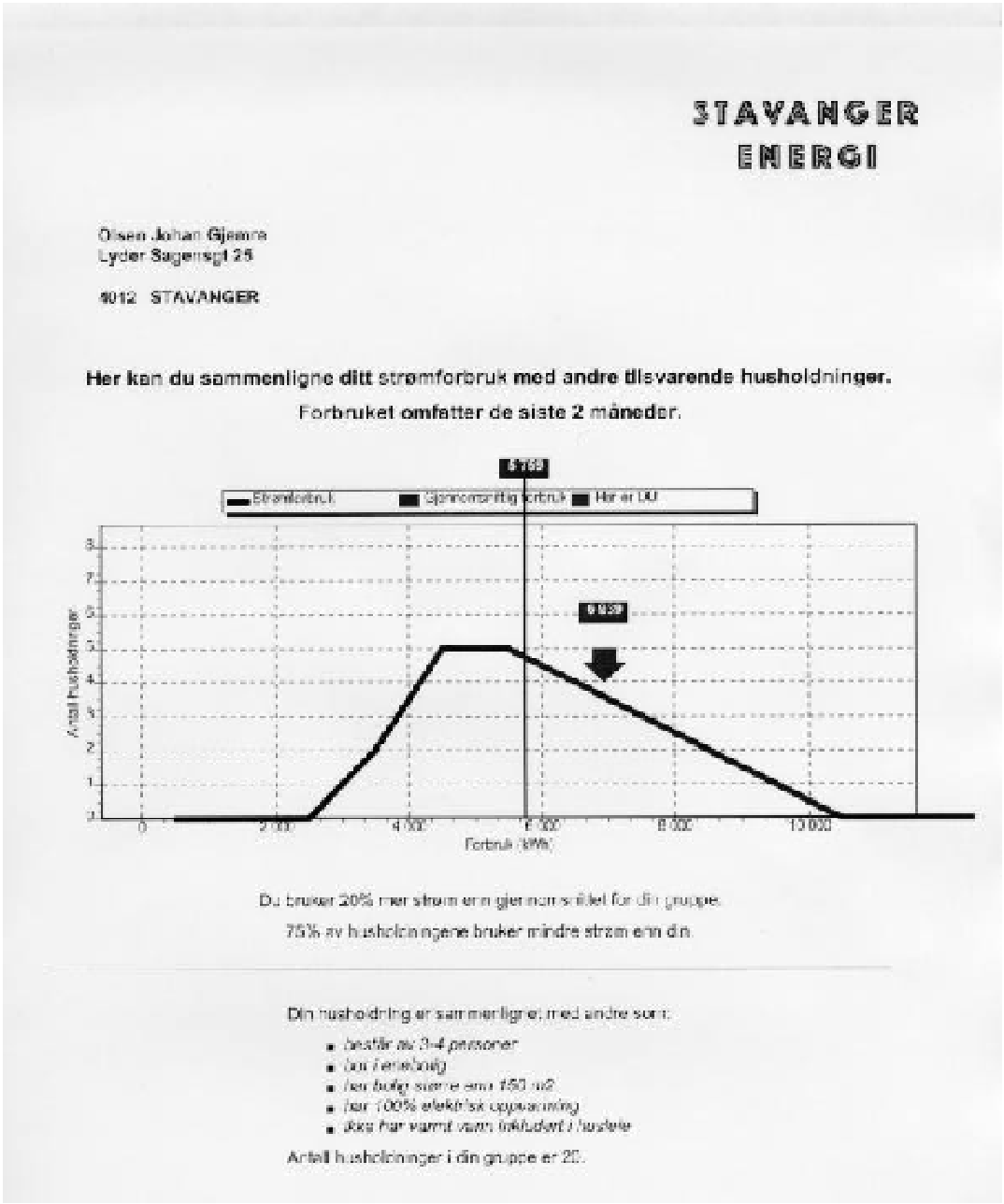

Figure 6. Normal distribution curve tested in the Stavanger study of normative feedback. This display shows the same information as the graph displayed in Figure 5.

Appendix F

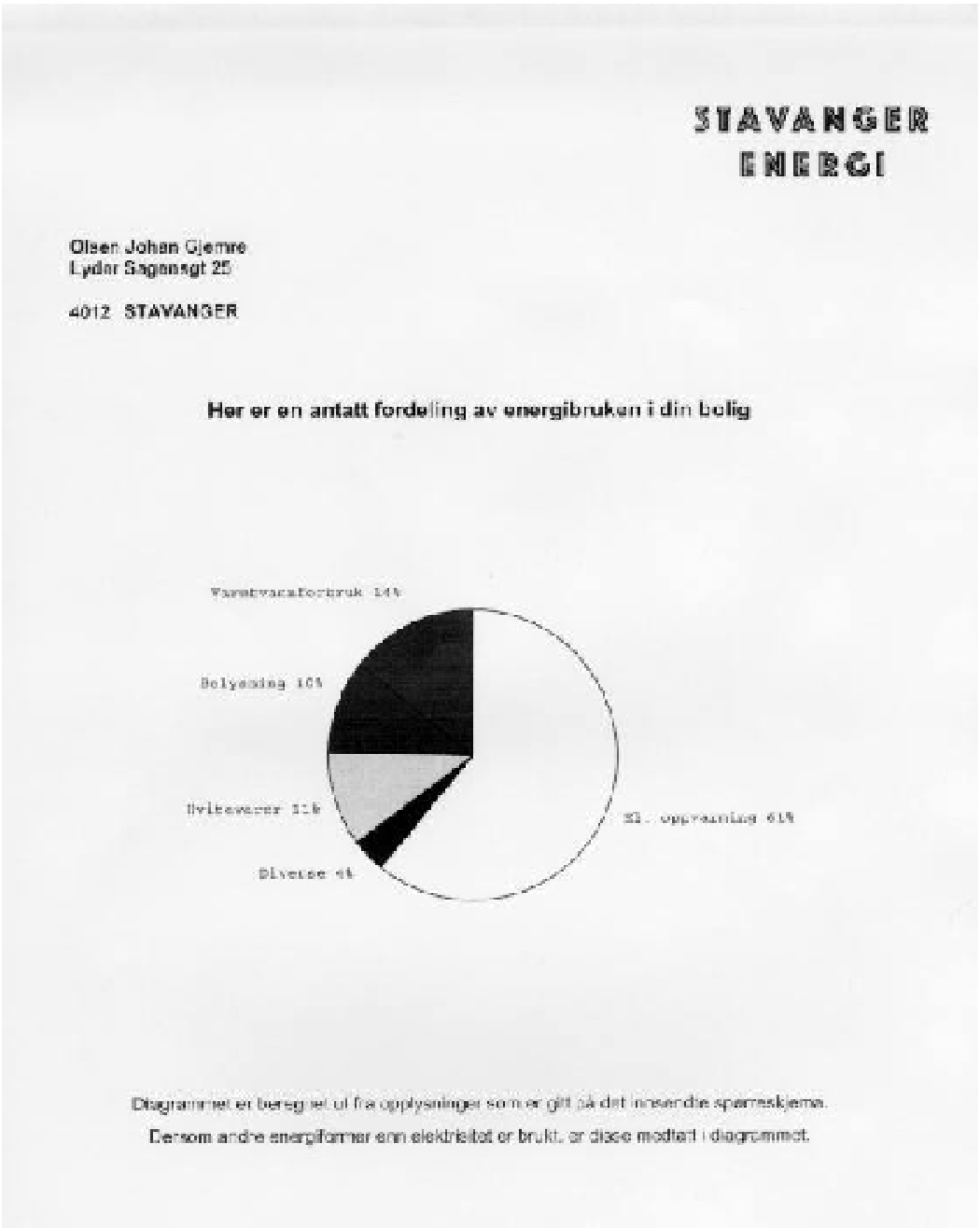

Figure 7. Pie chart showing disaggreated end uses of electricity in the household used in the Stavanger Energi study.