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THE 2001 SUPERMARKET PANEL ENERGY MANAGEMENT STUDY

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ABSTRACT

Energy costs are a major concern for supermarket operators, since they typically represent the third largest operating expense after the cost-of-goods sold and labor. Supermarkets may also be some of the largest customers of electricity in an area and have a high "base load" (stable) demand. In September 2001, a supplemental energy management survey was sent to stores participating in the 2001 Supermarket Panel to gain insights into how grocery retailers are addressing the energy challenge. There are significant differences in energy management and energy costs across stores grouped by ownership group size, store format and region. Larger stores and those with higher sales per square foot are typically more advanced in energy management. In particular, the results identify the characteristics of stores that are most receptive to energy management and cost conservation initiatives.

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1. Introduction

Energy availability and cost are critical concerns for today's supermarket operators. Exceeded only by cost-of-goods-sold and labor, energy is the third largest operating expense for most stores. Given the size of this expense, increases in electricity and natural gas prices, questions of availability and reliability, and the public policy debate on energy rates and utility siting issues, energy is a topic that merits continuing attention.

At the same time, the importance of the supermarket industry to electricity suppliers should not be overlooked. In aggregate terms, a grocery retail organization with a market share in excess of 20% in any major market is probably among the largest customers of electricity in that market place. This is made even more important by the relatively constant demand supermarkets have for electricity in comparison to other customers. Grocery stores are typically "high base load customers," using a nearly constant amount of power 365 days a year, 24 hours a day. This consistency makes supermarkets very desirable customers from the perspective of electricity suppliers. (See Appendix A for further explanation.)

To better understand how grocery retailers are addressing the energy challenge, a supplemental survey on energy management was sent to participating stores in the 2001 Supermarket Panel in September 2001. The Supermarket Panel collects data annually from individual supermarkets on store characteristics, operations and performance. The Panel is unique because the unit of analysis is the individual store and the same stores are tracked over time. Tracking the same stores over time makes it possible to analyze the process by which new technologies, business practices, and competitive forces are changing the industry.

The Panel has been gathering information on stores' adoption of energy efficient lighting and refrigeration management since 1999. The supplemental survey collected more detailed information on energy management technologies and practices used at the store level.

The remainder of this report begins with a description of the energy management situation in early 2001, drawing on findings from the 2001 Supermarket Panel and trade press accounts of the energy crisis that was emerging in some parts of the country during the first half of 2001. In Sections 3 and 4 we describe the design of the supplemental survey and present a descriptive analysis of store-level energy management practices. In Sections 5 and 6 we present findings from a more comprehensive analysis of factors associated with adoption of energy management technologies and practices and energy costs. Finally, in Section 7 we summarize our findings and discuss the implications for food retailers, energy suppliers, and providers of energy management expertise.

2. Energy Management Issues Facing Supermarkets in 2001

Interest in energy-related issues was higher than normal in late 2000 and the first six months of 2001. Brownouts and rolling blackouts were common, especially in California, and energy prices rose sharply in many parts of the country, especially in the West. At the same time, development of energy-saving technologies and deregulation of energy markets were creating new opportunities for more effective energy management in energy intensive businesses such as supermarkets.

Energy management was receiving increased attention in the media during this period. Table 2.1 lists electricity-related articles in *Supermarket News*, a widely read weekly trade publication for the supermarket industry. While there were only two articles on this subject in 2000, there were eight articles in 2001. These focused on impacts of energy shortages and rising energy costs and on the strategies retailers were adopting in response to the situation.

Energy rates differ considerably across states and sectors, and not all states and sectors experienced rapid rate increases in 2001. Table 2.2 presents average electricity rates for January 2000 through 2002 for seven selected states. In general, commercial and industrial customers have lower rates, and the states in the Midwest and South enjoy rates that are well below those in the Northeast and in California. Looking at the rate changes in individual states, in Connecticut electricity rates were essentially steady across the three years for residential and commercial users. In neighboring New York, commercial customers experienced a large rate increase in 2001, with rates retreating in 2002 but not back to 2000 levels. Residential customers experienced a somewhat smaller rate increase in 2001, with rates falling back to 2000 levels in 2002; and industrial users saw a modest upward trend in rates. In Illinois there was no clear

Table 2.1. Timeline for Energy-Related Stories and Supermarket Panel Data Collection

Date	Article Headlines from *Supermarket News*	Supermarket Panel and Energy Study Activities
Feb-00		2000 Supermarket Panel Data Collection
Mar-00		2000 Supermarket Panel Data Collection
Apr-00		2000 Supermarket Panel Data Collection
18-Sep-00	California Supermarkets are on the Front Lines of the Nations Biggest Energy Battle	
18-Sep-00	Generating Savings	
Oct-00		2000 Supermarket Panel Annual Report Released
29-Jan-01	California Looks to Raise Store Utility Rates	
05-Feb-01	The Lessons in California's Dim Light: The Golden State is low on Electricity. The Effects on Retailing are Growing. --- Editorial	2001 Supermarket Panel Data Collection
05-Feb-01	California Retailers Told Higher Rates Likely	2001 Supermarket Panel Data Collection
19-Feb-01	The Lights Dim --- Letter supporting previous editorial	2001 Supermarket Panel Data Collection
Mar-01		2001 Supermarket Panel Data Collection
16-Apr-01	Safeway Earnings Up Despite Fuel Cost Hike	2001 Supermarket Panel Data Collection
Jul-01		Energy Survey Questionnaire Prepared
10-Sep-01	Raley's and Other Operators Continue to Maintain Conservation Efforts While Keeping an Eye on the Future.	
17-Sep-01	Raley's to Test Self-Generation of Power in California	Energy Survey Data Collection
24-Sep-01	Retail Execs: Pay attention to California Energy Crisis	Energy Survey Data Collection
Oct-01		Energy Survey Data Collection
Nov-01		2001 Supermarket Panel Annual Report Released
Feb-02		2002 Supermarket Panel Data Collection
Mar-02		2002 Supermarket Panel Data Collection
15-Apr-02	Preventing Cold Shock: Weighing Kilowatt Hours Per Cubic Foot Against Degrees Can Mean Profits Gained or Lost in Perishables and Frozen Goods Distribution as Operators Move to Control Energy Costs.	2002 Supermarket Panel Data Collection

trend in rates across customer classes, while in both Southern states rates generally trended up modestly. In California, customers in all three classes have seen steady rate increases, with the sharpest rise being in 2001. Commercial and industrial customers saw especially large rate increases. Residential and commercial customers in Washington, on the other hand, did not see large rate increases until 2002, but the rate for industrial users increased sharply in 2001.

Table 2.2 Estimated Average Revenue (¢/KWH) to Ultimate Consumer by Sector for the Month of January

	Residential			Commercial			Industrial		
	2000	**2001**	**2002**	**2000**	**2001**	**2002**	**2000**	**2001**	**2002**
Northeast									
• **Connecticut**	10.5	10.7	10.6	9.2	9.2	9.1	7.5	8.1	7.8
• **New York**	12.9	13.7	12.9	10.3	12.2	11.2	4.7	4.9	5.1
Midwest									
• **Illinois**	7.8	7.5	7.5	6.5	5.8	7.2	4.4	4.1	5.2
South									
• **Florida**	7.6	8.1	8.4	6.1	6.8	7.0	4.7	5.2	5.4
• **Tennessee**	6.3	6.1	6.3	5.8	6.2	6.4	4.4	4.6	4.2
West									
• **California**	10.3	11.2	12.3	8.1	11.1	12.2	5.2	8.7	8.2
• **Washington**	5.3	5.2	6.5	5.1	5.1	6.3	2.9	5.9	NM
U.S. Average	7.62	7.74	7.99	6.79	7.35	7.58	4.14	5.02	4.81

Source: Energy Information Administration, Form EIA-826, Table 53

Concerns about the "energy crisis" eased as energy rates in most regions fell in the second half of 2001 and early 2002. Nevertheless, it is important to recognize that the potential for energy shortages and rising energy costs did not disappear. In early 2003, natural gas prices spiked upward, and energy experts believe the long term trend will bring continuing price increases. Because a greater percentage of electricity is now generated in cleaner-burning natural gas-fired plants, this also points to an upward trend in electricity rates. In addition, with uncertainty about the situation in the Mideast, there is renewed interest in strategies for energy independence. These strategies are likely to place increased emphasis on "green energy" sources. Finally, the future direction and scope of deregulation in energy markets also remain uncertain. Therefore, commercial and residential energy customers still face the long run challenge of managing energy use more effectively.

The 2001 Supermarket Panel collected information on store-level adoption of two important energy management practices: energy efficient lighting and refrigeration management. Refrigeration accounts for almost two-thirds of a typical store's energy consumption. While lighting does not account for such a large part of total energy consumption, the importance of lighting in merchandise presentation makes this an area of continual importance. Findings reported in the *Annual Report* for the 2001 Panel[1] are summarized in Table 2.3. They indicate that adoption of energy efficient lighting and refrigeration management differed across ownership group size categories, store formats, and regions. Stores in larger ownership groups were much more likely to have adopted these technologies, with differences in adoption across group sizes being especially noteworthy for refrigeration management. For stores grouped by format, upscale and food/drug combination stores were more likely to have adopted energy efficient lighting, and conventional stores stand out for their low rate of adoption of refrigeration management. These patterns are explained, in part, by the fact that stores in smaller ownership groups and conventional stores tend to be older, smaller, and more likely to be located in non-

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[1] King, Robert P., Elaine M. Jacobson, and Jonathan M. Seltzer. *The 2001 Supermarket Panel Annual Report*. St. Paul, MN: University of Minnesota, The Food Industry Center, 2001.

metropolitan areas. Finally, there also were importance differences in adoption rates across regions. Stores in the Northeast and West, where energy rates are generally higher, had higher adoption rates for both technologies.

Table 2.3 Adoption Rates of Energy Efficient Lighting and Refrigeration Management by Stores Grouped by Ownership Group Size, Format, and Region

	Percent of Stores Adopting	
	Energy Efficient Lighting	**Refrigeration Management**
OWNERSHIP GROUP SIZE		
• **Single Store**	67	41
• **2 - 10 Stores**	72	50
• **11 - 30 Stores**	71	55
• **31 - 60 Stores**	67	67
• **More than 60 Stores**	89	84
FORMAT		
• **Conventional**	71	59
• **Upscale**	90	75
• **Food/Drug Combination**	92	76
• **Warehouse**	83	75
REGION		
• **Midwest**	76	56
• **Northeast**	81	77
• **South**	73	62
• **West**	86	70

Trends in adoption of energy efficient lighting and refrigeration management for stores grouped by ownership group size were also reported in the *Annual Report* for the 2001 Panel.

These are presented in table 2.4. Stores in the largest ownership groups had adopted both technologies much earlier, and projected future rates of adoption were much higher. For energy efficient lighting, there were few noteworthy differences in adoption patterns for stores in ownership groups with fewer than sixty stores. On the other hand, single store independents lagged far behind other stores in adoption of refrigeration management. Again, it is important to note that these differences are probably driven more by store characteristics and store location than by lack of knowledge or concern about energy management issues.

Table 2.4 Adoption Patterns for Energy Efficient Lighting and Refrigeration Management by Stores Grouped by Ownership Group Size

	Singe Store	2 - 10 Stores	11 - 30 Stores	31 - 60 Stores	More than 60 Stores
ENERGY EFFICIENT LIGHTING					
• **Used More than 1 Year (%)**	64.7	66.7	65.8	58.7	79.4
• **Started in Past Year (%)**	2.1	5.1	5.2	8.3	9.3
• **Plan to Start Next Year (%)**	8.9	4.7	7.3	6.6	2.5
• **No Plans to Use/Don't Know (%)**	23.1	20.0	21.7	22.9	7.2
REFRIGERATION MANAGEMENT					
• **Used More than 1 Year (%)**	34.4	45.5	54.7	59.2	81.5
• **Started in Past Year (%)**	6.1	4.2	0.0	7.9	2.3
• **Plan to Start Next Year (%)**	7.7	10.8	4.5	7.0	2.3
• **No Plans to Use/Don't Know (%)**	50.1	35.7	40.9	25.9	14.0

Source: *The 2001 Supermarket Panel Annual Report*, p. 63.

3. Design and Administration of the Energy Management Survey

The Energy Management Survey was developed during the summer of 2001 to provide more detailed information on energy costs and energy management practices in supermarkets. The design of the survey instrument was based on findings from the Supermarket Panel, readings in the trade press, and collaboration by Robert King and Jonathan Seltzer with an independent energy management expert, Bill Poppert, President of Technology North.

The survey instrument was designed to gather data related to five general hypotheses about energy management in supermarkets.

1. The most frequently used energy management practices are (a) the least invasive to store operating practices/ flexibility and (b) are most heavily concentrated in areas with a known and identifiable payback. We expected to find the use of energy efficient lighting to be the most common practice. Lighting efficiency has been a widely discussed topic for many years and a more efficient lighting system can be added to a store with less disruption than other changes. In comparison, even though refrigeration management systems can have a high payback, changes to a store's refrigeration system are more challenging because they require consideration of the humidity in the store, existing refrigeration cases, flooring, etc.
2. Stores that are part of larger organizations are more likely than single store operators to adopt energy management technologies and more sophisticated energy management practices. There can be size economies in learning about all phases of energy purchasing, usage and management. Experiences with the transition to new technologies and practices in one store can be more readily transferred to other stores when all are part of

the same company. Also, larger organizations may be more likely to be sought out by electric utilities as part of their demand management and conservation efforts, since agreements for a large number of stores under common ownership can be negotiated simultaneously.

3. Stores that have more of their sales generated by perishable, refrigerated products are more likely to utilize more, and more sophisticated, energy management techniques than stores that are more dependent on dry grocery sales.
4. Stores in geographic areas that have suffered reliability problems or are in areas with higher rates (most notably California) are more likely to utilize more, and more sophisticated, energy management techniques than stores in other parts of the country.
5. Stores that have a formal energy plan and/ or have someone whose primary responsibility is energy management will utilize more energy management practices and have lower energy costs than stores that do not.

The survey instrument for the Energy Management Survey is reproduced in Appendix B.

The Energy Management Survey was sent to all 590 stores that participated in the 2001 Supermarket Panel. Of these, 566 stores were part of the Panel by virtue of being selected at random in 2000 or 2001 or invited to participate through IGA. The remaining stores were part of a non-randomly selected group that had joined the Panel during a pilot test in 1999.

Data collection, coding, and entry were administered and performed by the Minnesota Center for Survey Research (MCSR) at the University of Minnesota. This helped ensure not only smooth operations during the data collection process but also strict confidentiality for the data collected.

The first mailing for the study was sent to store managers on September 7, 2001. It included: a cover letter from Robert King and Jon Seltzer of The Food Industry Center inviting participation in the study, the survey instrument, and a stamped return envelope. A reminder postcard was mailed to all store managers on September 14, 2001. Finally, a second packet with a cover letter, survey instrument, and return envelope was mailed to all stores that had not yet responded on September 28, 2001. Responses continued to be received until October 22, 2001. Useable questionnaires were returned by 264 stores, for a response rate of 45%. Ten of these responses were from non-randomly selected pilot stores. An additional three stores lacked data on ownership group size, a key variable in the analysis. These thirteen stores were excluded from the analysis, reducing the number of respondents for this analysis to 251.

Coding/editing of returned surveys, data entry, and data file cleaning were completed in early November by MCSR personnel. In December 2001, Elaine Jacobson, who manages the Supermarket Panel database for The Food Industry Center, prepared and mailed a benchmark report for each survey participant. This report presented question-by-question comparisons of the store's responses to those made by other stores similar in selling area and format.

Data from the Energy Management Survey were merged with detailed data on store characteristics and operating practices collected in the 2001 Supermarket Panel. This makes it possible to investigate how energy costs and energy management practices are related to a wide range of other factors that describe store characteristics. It also makes it possible to compare the characteristics of respondent and non-respondent stores to determine how representative the respondent stores are of the entire 2001 Supermarket Panel. Descriptive profiles for the two groups of stores are presented in Table 3.1. Sample observations are unweighted in the two columns on the left. Sample observations are weighted to account for differences in sampling intensity and response rates in the two columns on the right. Only two descriptive measures: the percent of stores that are wholesaler supplied for the unweighted data and payroll as a percent of sales for the weighted data are significantly different at the ten percent level. Therefore, it can be concluded that the stores that responded to the energy management survey are generally representative of all the stores in the 2001 Supermarket Panel.

Table 3.1. Descriptive Profiles of the Respondent and Non-Respondent Stores

	Unweighted		**Weighted**	
	Non-Respond	**Respond**	**Non-Respond**	**Respond**
NUMBER OF STORES	322	254	17,142	14,315
STORE AND MARKET CHARACTERISTICS				
• Median Selling Area (sq. ft.)	21,500	21,000	29,000	29,000
• Median Store Age (years)	22	24	18	23
• Median Number of Stores in Store Group	5	4	50	19
• Percent of Wholesaler Supplied	69	72	47	54*
• Percent Located in SMSA	58	54	67	65
MEDIAN PERFORMANCE MEASURES				
• Weekly Sales	$140,000	$140,000	$203,000	$225,000
• Weekly Sales per Square Foot	$7.20	$7.32	$7.31	$7.77
• Sales per Labor Hour	$98.79	$99.40	$105.58	$108.13
• Sales per Transaction	$17.50	$17.46	$21.13	$20.39
• Annual Inventory Turns	16.0	16.0	17.0	16.0
• Percent Employee Turnover	42.9	40.0	44.2	43.4
• Gross Profit as a Percent	24.0	24.0	24.0	24.1
• Payroll as a Percent of Sales	10.0	10.4*	9.7	10.0
• Annual Percentage Sales	2.3	2.1	2.9	3.2

* Difference is statistically significant at the 10 percent level.

Finally, a new set of weights was constructed for stores in the energy management survey to account for differences in responses for stores grouped by ownership size and region. This makes it possible to extrapolate findings for the 254 stores in the survey to the entire population of supermarkets in the U.S. Weights were constructed using procedures described in Appendix A of *The 2001 Supermarket Annual Report*. The respondents were divided into twelve strata based on four regions (Midwest, Northeast, South, and West) and three ownership group strata (1 to 10 stores, 11 or more stores, and IGA affiliates). The resulting weights indicate the number of stores in the population represented by each store in the sample. Weights are reported in Table 3.2. Unless noted otherwise, all analyses in this report are based on weighted data.

Table 3.2 Statistical Weights by Ownership Stratum and Region

	Midwest	Northeast	South	West
1 to 10 Stores	77	224	149	149
11 or More Stores	152	364	233	190
IGA Stores	16	31	52	12

4. Supermarket Energy Practices

Data on adoption of two energy management technologies – energy efficient lighting and refrigeration management – have been collected each year in the regular Supermarket Panel. The energy management survey offered an opportunity to collect adoption data on a more detailed set of energy management technologies and practices. These included:

- T-8 lighting, outdoor high pressure lighting, and other energy efficient lighting
- refrigeration improvement
- heat recovery from the store's heating, ventilation, and air conditioning system (HVAC) and from refrigeration for use in water or spacing heating
- automated energy management systems (EMS) that monitor energy usage and shut off unneeded lighting, heat, or refrigeration
- load shedding agreements with energy providers under which the store temporarily switches to its own generator in response to request from the energy provided when system-wide demand is high
- demand controllers that measure how much electricity the store is using and prevent certian pieces of equipment from coming on at the same time, thereby reducing peaks in the demand for electricity.

Table 4.1 summarizes energy management adoption patterns for stores grouped by ownership group size. The right-hand column of the table presents overall adoption rates for all stores. Consistent with findings from the regular Supermarket Panel and with expectations, stores that are part of larger ownership groups are generally more likely to have adopted energy management technologies, but this is not always the case. Differences in adoption rates are especially noteworthy for heat recovery from HVAC and refrigeration, use of an EMS to control HVAC, use of load shedding, and use of demand controllers. On the other hand, stores in smaller ownership groups have higher adoption rates for outdoor high pressure sodium lighting, and there is no clear pattern across ownership group size for other energy efficient lighting and refrigeration improvement.

Table 4.1. Energy Management Technology Adoption for Stores Grouped by Ownership Group Size

	Single Store	2 -10 Stores	11 - 30 Stores	31 - 60 Stores	> 60 Stores	All Stores
NUMBER OF STORES REPRESENTED*	6,343 (93)	5,346 (58)	3,584 (28)	2,268 (10)	13,722 (62)	31,263 (251)
ADOPTION RATE (Percentage)						
• **T-8 Lighting**	42	45	58	29	55	49
• **Other Energy Efficient Lighting**	65	61	53	63	69	65
• **Outdoor High Pressure Sodium Lighting**	53	54	32	40	49	48
• **Refrigeration Improvement**	78	69	77	83	80	78
• **Heat Recovery from HVAC**	31	48	59	57	71	57
• **Heat Recovery from Refrigeration**	50	58	68	63	68	62
• **EMS to control HVAC**	18	24	36	73	60	44
• **Load Shedding**	7	9	15	43	21	17
• **Demand Controllers**	8	20	27	57	40	30

* Numbers in parentheses are actual (unweighted) store numbers.

Table 4.2 summarizes energy management adoption patterns for stores grouped by format. Stores with a conventional format have lower adoption rates for most energy management practices. In part, this can be explained by the fact that stores in the other formats generally offer more perishable and refrigerated products and have longer hours of operation. Also, conventional stores are usually older and smaller and have lower sales volumes. Installation of energy management technologies such as heat recovery and automated EMS can require costly retrofitting in older buildings, significantly increasing the investment cost. Furthermore, the cost of such systems may not differ appreciably with store size, but cost savings from them are greater for larger stores.

Table 4.2. Energy Management Technology Adoption for Stores Grouped by Format

	CON	US	FD COMBO	WH
NUMBER OF STORES REPRESENTED*	17,785 (182)	2,672 (13)	8,706 (42)	2,100 (14)
ADOPTION RATE (Percentage)				
• **T-8 Lighting**	40	47	62	75
• **Other Energy Efficient Lighting**	59	81	70	69
• **Outdoor High Pressure Sodium Lighting**	45	51	51	58
• **Refrigeration Improvement**	71	94	89	62
• **Heat Recovery from HVAC**	47	70	67	73
• **Heat Recovery from Refrigeration**	60	78	64	58
• **EMS to control HVAC**	26	85	65	51
• **Load Shedding**	9	14	30	33
• **Demand Controllers**	18	37	49	44

* Numbers in parentheses are actual (unweighted) store numbers.

Table 4.3 summarizes energy management adoption patterns for stores grouped by region. There are only a few noteworthy differences in adoption rates across regions. The South has the lowest adoption rate for six of the eight technologies, and the West also has relatively low adoption rates. This may reflect differences in climate more than a lack of progressivity with regard to energy management. The relatively low adoption rates for load shedding and demand controllers in the West run counter to expectations, since deregulation of retail energy markets has progresses further in California than in other parts of the country.

Table 4.3. Energy Management Technology Adoption for Stores Grouped by Region

	Midwest	Northeast	South	West
NUMBER OF STORES REPRESENTED*	8,152 (119)	6,847 (28)	9,842 (55)	6,422 (49)
ADOPTION RATE (Percentage)				
• **T-8 Lighting**	59	44	39	57
• **Other Energy Efficient Lighting**	68	71	59	62
• **Outdoor High Pressure Sodium Lighting**	54	77	30	37
• **Refrigeration Improvement**	76	83	75	79
• **Heat Recovery from HVAC**	62	56	51	58
• **Heat Recovery from Refrigeration**	74	64	56	55
• **EMS to control HVAC**	43	49	36	49
• **Load Shedding**	19	19	16	12
• **Demand Controllers**	32	35	26	27

* Numbers in parentheses are actual (unweighted) store numbers.

Effective use of energy management technologies requires planning, continuous monitoring, and careful management. Often energy management expertise is lacking at the store level, and store managers may rely on energy management services provided by the corporate office of their ownership group, by their wholesaler, or by an independent consultant. Tables 4.4 through 4.6 summarize responses for stores grouped by ownership group size, format, and region to the following three questions on energy management practices.

- "Who has primary responsibility for your store's energy management?"
- "Do you have a formal energy management program?"
- "How do you track real-time energy use?

Table 4.4. Energy Management Practices for Stores Grouped by Ownership Group Size

	Single Store	2 -10 Stores	11 - 30 Stores	31 - 60 Stores	> 60 Stores	All Stores
RESPONSIBILITY FOR ENERGY MANAGEMENT (Percentage)						
• **Owner/Manager**	100	82	47	24	29	54
• **Corporate or Regional**	0	14	33	56	68	40
• **Energy Professional/Wholesaler**	0	0	0	0	0	0
• **Independent Energy**	0	0	4	0	1	1
• **Equipment Representative**	0	4	4	10	1	3
• **Don't Know**	0	0	12	10	0	2
FORMAL ENERGY MANAGEMENT PROGRAM (Percentage)						
• **Yes**	13	14	51	62	80	51
• **No**	87	81	48	10	14	43
• **Don't Know**	0	5	0	27	6	6
TRACKING REAL-TIME ENERGY USE (Percentage)						
• **Readings from Store EMS**	1	1	6	0	5	3
• **Bills/Invoices from Utility**	42	61	50	29	37	43
• **Third-Party Off-Site**	0	0	0	0	8	4
• **Don't Track Real-Time Energy**	46	32	17	17	29	31
• **Don't Know**	11	6	28	54	20	19

Table 4.5. Energy Management Practices for Stores Grouped by Format

	CON	US	FD COMBO	WH
RESPONSIBILITY FOR ENERGY MANAGEMENT (Percentage)				
• **Owner/Manager**	69	38	35	33
• **Corporate or Regional**	25	56	60	60
• **Energy Professional/Wholesaler**	0	0	0	0
• **Independent Energy**	0	6	2	0
• **Equipment Representative**	3	0	2	7
• **Don't Know**	4	0	0	0
FORMAL ENERGY MANAGEMENT PROGRAM (Percentage)				
• **Yes**	30	73	81	73
• **No**	64	21	14	27
• **Don't Know**	6	6	5	0
TRACKING REAL TIME ENERGY USE (Percentage)				
• **Reading from Stores EMS**	2	15	4	4
• **Bills/Invoices from Utility**	43	39	42	51
• **Third-Party Off-Site**	3	0	7	0
• **Don't Track Real-Time Energy**	38	19	20	31
• **Don't Know**	15	27	27	14

There are striking differences in responses across ownership group sizes. The owner/manager is responsible for energy management in the great majority of stores in ownership groups with ten or fewer stores, and relatively few stores in these smaller ownership groups have a formal energy management plan. In contrast, responsibility for energy management shifts outside the store – usually to a corporate or regional specialist – in the larger ownership groups, and stores in these larger groups are much more likely to have a formal energy management plan.

Table 4.6. Energy Management Practices for Stores Grouped by Region

	Midwest	Northeast	South	West
RESPONSIBILITY FOR ENERGY MANAGEMENT (Percentage)				
• **Owner/Manager**	66	51	49	51
• **Corporate or Regional**	28	46	44	43
• **Energy Professional/Wholesaler**	0	0	0	0
• **Independent Energy**	2	0	0	3
• **Equipment Representative**	2	3	2	3
• **Don't Know**	2	0	5	0
FORMAL ENERGY MANAGEMENT PROGRAM (Percentage)				
• **Yes**	43	62	41	65
• **No**	52	38	48	32
• **Don't Know**	5	0	11	3
TRACKING REAL TIME ENERGY USE (Percentage)				
• **Reading from Stores EMS**	3	5	1	6
• **Bills/Invoices from Utility**	47	51	31	45
• **Third-Party Off-Site**	2	5	2	6
• **Don't Track Real-Time Energy**	27	25	40	30
• **Don't Know**	21	14	26	12

Bills and invoices from the utility are the most common method of tracking real-time energy use across all ownership group size categories, but it is noteworthy that a large proportion of store managers in larger ownership groups do not know how real-time energy use is tracked.

For stores grouped by format, responses to these questions about energy management practices are notably different for conventional stores, but this may be due to the fact that a larger proportion of conventional stores are in smaller ownership groups. As for stores in smaller ownership groups, managers of conventional stores are more likely to be responsible for energy management, and stores with a conventional format are less likely than stores in other formats to have a formal energy management plan.

Finally, for stores grouped by region, it is noteworthy that stores in the Northeast and West are more likely to have formal energy management plans and that store managers in these regions are more likely to know how real-time energy use is tracked for their stores. This may reflect a response to higher energy rates and more problems with energy supply disruptions in these regions.

Store energy costs per square foot are expected to vary with store format and location. Store format is associated with differences in the proportion of selling area allocated to refrigerator and freezer cases, which can have important impacts on energy cost. Similarly, climate and energy prices can differ considerably across regions, having important impacts on energy costs per square foot. Adoption of energy management technologies and practices is also expected to influence energy costs. Findings already presented in this section suggest that adoption patterns for many technologies and practices are associated with store ownership group size. Table 4.7 presents median electricity and natural gas rates and median energy costs per square foot of selling area for stores grouped by ownership group size, format, and region.

There is no clear pattern in energy rates for stores grouped by ownership group size, but there is a striking difference in energy cost per square foot of selling area between stores in the groups with ten or fewer stores and stores in groups with eleven or more stores. There are many factors that could be driving this result, including differences in store size, age, format, and region that are associated with ownership group size. It is also noteworthy, though, that stores in

Table 4.7. Median Energy Prices and Costs for Stores Grouped by Ownership Group Size, Format, and Region

	Median Electricity Rate (¢/KWH)	Median Natural Gas Rate ($/1,000 cu.ft.)	Median Energy Cost ($/sq.ft. of Selling Area)
OWNERSHIP GROUP SIZE			
• **Single Store**	6.51	7.02	5.09
• **2 - 10 Stores**	6.51	6.48	5.31
• **11 - 30 Stores**	6.16	6.02	3.83
• **31 - 60 Stores**	6.02	7.02	3.47
• **More than 60 Stores**	7.31	7.41	4.25
FORMAT			
• **Conventional**	6.40	6.92	4.37
• **Upscale**	7.90	7.54	7.79
• **Food/Drug Combination**	7.35	6.92	4.15
• **Warehouse**	6.25	7.41	2.61
REGION			
• **Midwest**	6.22	6.68	4.08
• **Northeast**	9.27	7.72	6.38
• **South**	6.40	7.61	3.83
• **West**	9.30	6.69	5.31

larger groups tend to be somewhat more advanced in adoption of energy management technologies and are much more likely to rely on experts outside the store for energy management and to have a formal energy plan. This suggests that energy management technology and practice adoption may lower store energy costs per square foot of selling area.

For stores grouped by format, there is no clear pattern in energy rates, but upscale and warehouse stores stand out for their dramatically higher and lower respective energy costs per square foot of selling area. This is not surprising, since upscale stores generally devote more space than stores in other formats to frozen and refrigerated products. Store size may be a key factor in keeping energy cost per square foot low for warehouse stores. In general, heating and air conditioning efficiency rises with store size. Similarly, the larger refrigerator and freezer cases used in warehouse stores are usually more energy efficient.

Finally, for stores grouped by region, the higher electricity rates and energy cost per square foot of selling area for stores located in the Northeast and West are noteworthy. Findings reported earlier indicate that stores in these regions are more likely to have a formal energy plan and that managers in these regions are more likely to be knowledgeable about real-time energy use tracking.

5. Statistical Analysis of Energy Management Practice and Technology Adoption

The descriptive tables in the preceding section offer useful insights on store level adoption of energy management practices and technologies and store level energy costs, but their value is limited by a failure to consider interactions among ownership group size, store format, and store location. This section presents a more comprehensive statistical analysis of energy management adoption patterns. Eight practices and technologies are considered:

- Adoption of a formal energy management plan
- Responsibility for energy management assigned to a specialist outside the store
- Adoption of energy efficient lighting – T-8, other energy efficient lighting, and/or outdoor high pressure sodium lighting
- Refrigeration improvement
- Heat recovery from HVAC and/or refrigeration
- EMS to control HVAC
- Load shedding
- Demand controllers

Decisions about the adoption of energy management practices and technologies are based on assessments of both the benefits and costs of adoption. Larger benefits and/or lower costs should increase the likelihood of adoption. Benefits and costs are, in turn, affected by the store's operating environment and characteristics. In this analysis, we consider four broad categories of factors that affect adoption decisions.

Ownership Group Size should not have any impact on the benefits of adopting energy management practices and technologies, but it can influence adoption costs for some practices and technologies. Companies that own a large number of stores can hire energy management specialists who are based in a corporate or regional office and serve a large number of stores. These specialists can help stores develop more effective energy management plans and can help them with the evaluation and installation of complex energy management technologies. These specialists can also work with energy utilities to negotiate reduced energy rates for stores that use load shedding and demand controller technologies. It may be more difficult for companies with fewer stores to maintain this type of expertise within their organization. Therefore, holding everything else constant, we expect larger ownership group size to be associated with a higher likelihood of adoption for practices and technologies where expertise has an important impact on cost. We represent ownership group size with a set of binary variables for ownership groups of two to ten, eleven to thirty, thirty-one to sixty, and more than sixty stores. A single store independent is considered the "base case" situation.

Format is associated with store layout and product mix. These, in turn, are expected to affect energy usage and the benefits of adopting practices and technologies that conserve energy. Upscale and food/drug combination stores generally devote more space to and derive more of their sales from refrigerated and frozen products. Therefore, holding everything else constant, we expect stores with these formats to be more likely to adopt energy conserving technologies, especially those related to refrigeration. We represent format with a set of binary variables for upscale, food/drug combination, and warehouse formats. A store with a conventional format is considered the "base case" situation.

Region affects energy cost through differences in energy rates, climate, and energy infrastructure. Electricity rates are generally higher in the Northeast and West, so stores in these regions are likely to benefit more from practices and technologies that help reduce electricity use. Similarly, the climate in the Midwest is such that both heating and air conditioning costs are high. Therefore, stores in the Midwest may benefit more than stores in other regions from heat recovery and automated energy management systems for HVAC. Finally, regional differences in the programs utilities offer to assist customers and encourage conservation may affect the adoption of some conservation practices. It is difficult to make general predictions that are linked to region, but it may affect adoption rates in some cases. We represent region with a set of binary variables for Northeast, South, and West. A store located in the Midwest is considered the "base case" situation.

Store Characteristics can be related to both the benefits and costs of energy management practice and technology adoption. For example, larger stores and stores that are open more hours are more likely to benefit from energy conserving practices and technologies. The cost of installing some energy management technologies is lowest at the time when a store is built or when it is undergoing a major remodeling. Therefore, older stores may be less likely and stores that have undergone a major remodeling may be more likely to adopt some technologies. Finally, stores with higher sales per square foot often have a higher proportion of sales from refrigerated and frozen products and so may benefit more from technologies that help control the costs of refrigeration. We represent store characteristics with four continuous variables – selling area, store age, hours open per week, and sales per square foot – and a binary variable to indicate whether or not the store has had a major remodeling. The four continuous variables are converted to natural logarithms, since we expect the incremental effects of each to diminish with size.[2]

The variables included in these four categories of effects are summarized in Table 5.1.

Table 5.1. Summary Information on Explanatory Variables in Adoption and Energy Cost Regression Models

Variable	Abbreviation	Comments
OWNERSHIP GROUP SIZE		
• 2 - 10 Stores	S2	1 if 2 - 10 stores, 0 otherwise
• 11 - 30 Stores	S3	1 if 11 - 30 stores, 0 otherwise
• 31 - 60 Stores	S4	1 if 31 - 60 stores, 0 otherwise
• More than 60 Stores	S5	1 if more than 60 stores, 0 otherwise
FORMAT		
• Upscale	US	1 if US, 0 otherwise
• Food/Drug Combination	FD	1 if FD, 0 otherwise
• Warehouse	WH	1 if WH, 0 otherwise
REGION		
• Northeast	NE	1 if NE, 0 otherwise
• South	SO	1 if SO, 0 otherwise
• West	WEST	1 if WEST, 0 otherwise
STORE CHARACTERISTICS		
• Selling Area	SellArea	natural log of selling area
• Store Age	Age	natural log of store age
• Major Remodeling	Remod	1 if store has been remodeled, 0 otherwise
• Hours Open	HrOpen	natural log of hours open per week
• Sales per Square Foot	SArea	natural log of weekly sales per square foot

[2] The proportion of total store sales from groceries and the price of electricity were also considered as store characteristics, but these did not add significantly to the explanatory power of the models used in this analysis.

For any energy management practice or technology, we expect a store to adopt if the benefits from adoption exceed the costs, where benefits and costs depend on the ownership group size, format, region, and store characteristics variables listed in Table 5.1.. Adoption is a "yes/no" decision represented by a binary variable. The basic model used for each energy management practice and technology adoption decision is:

$$\begin{aligned}\mathbf{ADOPT}_{ij} = \beta_{i0} + \beta_{i1}\mathbf{S2}_j + \beta_{i2}\mathbf{S3}_j + \beta_{i3}\mathbf{S4}_j + \beta_{i4}\mathbf{S5}_j + \beta_{i5}\mathbf{US}_j + \beta_{i6}\mathbf{FD}_j + \beta_{i7}\mathbf{WH}_j \\ + \beta_{i8}\mathbf{NE}_j + \beta_{i9}\mathbf{SO}_j + \beta_{i10}\mathbf{WEST}_j + \beta_{i11}\mathbf{SellArea}_j + \beta_{i12}\mathbf{Age}_j \\ + \beta_{i13}\mathbf{Remod}_j + \beta_{i14}\mathbf{HrOpen}_j + \beta_{i15}\mathbf{SArea}_j + \epsilon_{ij}\ ,\end{aligned}$$

where $\mathbf{ADOPT}_{ij}$ is a binary variable for the i^{th} practice or technology and the j^{th} store, the $\boldsymbol{\beta}$'s are parameters to be estimated, and ϵ_{ij} is a random error term for the i^{th} practice or technology and the j^{th} store. The parameters for this model have been estimated for each of the eight energy management practices and technologies using the maximum-likelihood logit procedures in *Stata*, Release 6.0.[3] The data were weighted by the appropriate sampling weights from Table 3.2.

Table 5.2 summarizes qualitative results for these eight models.[4] Each practice or technology is associated with a column in the table, while each explanatory variable is associated with a table row. When the estimated coefficient for an explanatory variable is statistically significant at the 95% confidence level, two pluses (++) or minuses (- -) are placed in the appropriate performance variable column to indicate the sign of the coefficient. One plus (+) or

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[3] StataCorp. *Stata Statistical Software: Release 6.0*. College Station, TX: Stata Corporation, Reference H - O, pp. 228-239.

[4] Complete results are available on request from Robert King.

Table 5.2. Qualitative Results for Energy Management Practice and Technology Adoption*

	Energy Management Plan	Expert Energy Management	Energy Efficient Lighting	Refrigeration Management	Heat Recovery	Automated EMS	Load Shedding	Demand Controllers
OWNERSHIP GROUP SIZE								
• **2 - 10 Stores**		++		-				
• **11 - 30 Stores**	++	++			+			++
• **31 - 60 Stores**	+	++	--					
• **More than 60 Stores**	++	++			++	++		++
FORMAT								
• **Upscale**						++		
• **Food/Drug Combination**								
• **Warehouse**				--	-	-		
REGION								
• **Northeast**	++	++				-	-	--
• **South**		+		--	--	--		-
• **West**	+	++			--			-
STORE CHARACTERISTICS								
• **Selling Area**					++		++	+
• **Store Age**		--						-
• **Major Remodeling**							+	
• **Hours Open**		+						-
• **Sales per Square Foot**				++			++	

*The symbol "++" indicates a positive relationship that is statistically significant at the 95% confidence level, while the symbol "–" indicates a negative relationship that is statistically significant at the 95% confidence level. The symbol "+" and "-" indicate positive and negative relationships that are statistically at the 90% confidence level. Significance levels are based on a one-tailed test.

minus (-) indicates statistical significance at the 90% confidence level. For example, the relationship between membership in an ownership group with eleven to thirty stores and adoption of a formal energy management plan is positive and statistically significant at the 95% level, so there are two pluses in the cell at the intersection for the row and column for these variables.

Having a formal energy management plan and shifting responsibility for energy management to experts outside the store are closely related to ownership group size, with stores that belong to larger groups being more likely to adopt both these practices. Region is also an important factor associated with adoption of both practices, with the likelihood of adoption being especially high for stores in the Northeast and West. Finally, the likelihood of relying on outside experts for energy management decreases significantly with store age and increases with the number of hours the store is open each week.

The explanatory power of the model for energy efficient lighting is poor. This is probably due to the fact that more than 80% of stores have adopted at least one of the three technologies encompassed by this variable, leaving little variation to be explained by the model. There are also relatively few statistically significant variables in the model for adoption of refrigeration management. The highly significant, positive relationship for sales per square foot is consistent with expectations, since a higher level of sales per unit of selling area is often due to greater emphasis on refrigerated and frozen food items.

Adoption of heat recovery systems for refrigeration and HVAC and automated EMS to control HVAC is significantly higher among stores in the largest ownership group size category. Costs of adoption may be lower for these stores because they can more easily use outside expertise to help with evaluating and installing these relatively complex technologies. It is also noteworthy that adoption of these technologies tends to be lower for stores located in the South and West. This is probably due to climatic factors. The likelihood of a store having a heat recovery system increases significantly with store selling area, suggesting that this technology may not “scale down” well for use in smaller stores. Finally, the likelihood of adoption for automated EMS is significantly higher for upscale format stores, which tend to focus more on sales of refrigerated and frozen products.

Adoption of load shedding is closely related to store characteristics, with larger stores that have been remodeled and that have relatively high sales per square foot being most likely to use this practice. This makes good sense. These stores are large power consumers, and they would be among the first customers a utility would approach to discuss load shedding. Ownership group size and region seem to be key factors associated with the use of demand controllers. Once again, easier access to outside expertise may explain higher adoption rates by stores in larger ownership groups.

In summary, these results confirm the hypothesis that ownership group size is closely linked to adoption decisions for energy management practices and technologies that require technical expertise for successful implementation. After controlling for other factors, store format is not closely related to adoption decisions. On the other hand, regional location does help explain adoption decisions, especially for those practices and technologies that require some expertise. The fact that adoption rates tend to be higher in the Midwest suggests that assistance provided by utilities and/or public agencies may be substituting for expertise at the corporate level in this region. Finally, store characteristics, most notably selling area, age, and sales per square foot are associated with adoption of technologies and practices that require installation of expensive equipment and that yield energy cost savings that are proportional to store size and hours of operation

6. Statistical Analysis of Energy Costs

This section presents results of a statistical analysis of energy cost per square foot. The objective here is to explain as much as possible of the wide variation in energy costs across stores that was reported in Table 4.7. We are especially interested in the question of whether particular energy management practices and technologies are associated with significantly lower (or higher) energy costs.

We expected energy costs to be driven by several store characteristics. Other factors held constant, larger stores and stores that have been remodeled should have lower energy cost per square foot of selling area. In contrast, stores that are older, that open more hours per week, and that have higher sales per square foot should have higher energy cost per square foot. Finally, electricity rates in the store's location should also have a strong positive relationship with energy cost per square foot of selling area. Preliminary analysis confirmed the importance of selling area, sales per square foot, and electricity price in explaining energy costs. Store age, remodeling status, and hour open per week did not add explanatory power to any of the models we considered and so are excluded from the analysis presented here.

Regional location may also have a significant effect on energy cost, due to climate and the energy management "infrastructure" associated with utilities' focus on energy management and the regulatory environment. Of course, there are also significant regional differences in energy rates, so region may, along with electricity rate, pick up some of these effects. The descriptive results presented in Table 4.7 suggest that energy cost per square foot will be higher in the Northeast and West.

Ownership group size and store format were included in our models of energy management practice and technology adoption, and these factors were considered for inclusion in this analysis of energy management costs. Based on the large differences in energy costs across formats that are reported in Table 4.7, we expect upscale stores to have significantly higher energy costs. Differences in energy costs for stores grouped by ownership group size are less pronounced, though there is a tendency for energy cost to fall as ownership group size increases. Preliminary analysis indicated that, after controlling for store characteristics, regional location, and store format, ownership group size did not have a statistically significant association with energy costs. Therefore, this set of variables was excluded from the analysis presented here.

Adoption of energy management practices and technologies should lower energy costs. But including indicators of energy management practice and technology adoption in this analysis poses statistical problems Adoption decisions are likely to be driven, at least in part, by energy costs. Stores that have high energy cost per square foot of selling area are likely to be more highly motivated to adopt practices and technologies that help control energy usage. In effect, cost and adoption are simultaneously determined, and this can bias statistical results. We used two-stage least squares procedures to correct for this problem,[5] estimating energy cost relationships for each of the individual energy management practices and technologies considered in Table 5.3 and for a composite index that indicated the percentage of all these practices and technologies that a store had adopted. However, after controlling for other variables in the model, none of these variables had a statistically significant relationship with

[5] StataCorp. *Stata Statistical Software: Release 6.0*. College Station, TX: Stata Corporation, Reference H - O, pp. 120-128.

energy cost per square foot of selling area. The energy management practice that came the closest to having a statistically significant relationship with energy cost was reliance on an expert outside the store for energy management decisions.[6] Therefore, we present results here for models including and excluding a binary variable for adoption of this practice.

The final model used for the analysis of energy management cost is:

$$\mathbf{ECost_j = \beta_0 + \beta_1 US_j + \beta_2 FD_j + \beta_3 WH_j + \beta_4 NE_j + \beta_5 SO_j + \beta_6 WEST_j}$$
$$\mathbf{+ \beta_7 SellArea_j + \beta_8 SArea_j + \beta_9 EPrice_j + \beta_{10} ExMgt_j + \epsilon_j} ,$$

where $\mathbf{ECost_j}$ is energy cost per square foot of selling area for store j, $\mathbf{EPrice_j}$ is electricity cost for store j, $\mathbf{ExMgt_j}$ is a binary variable indicating reliance on an expert outside the store for energy management decisions for store j, $\boldsymbol{\beta_0}$ to $\boldsymbol{\beta_{10}}$ are parameters to be estimated, $\boldsymbol{\epsilon_j}$ is a random error term for store j, and all other variables are as defined in table 5.1. All continuous variables, including $\mathbf{ECost_j}$, were converted to natural logarithms. The data were weighted by the appropriate sampling weights from Table 3.2 prior to estimation. The "base case" situation for this model is a conventional store in the Midwest that does not rely on an expert outside the store for energy management decisions.

Table 6.1 presents regression results for the models including and excluding the expert energy management variable. The two two-stage least squares model that includes expert energy management explains nearly 59% of the variation in energy cost per square foot of selling area across stores in the sample, while the ordinary least squares model that excludes expert energy

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[6] The ownership group size binary variables were used as instrumental variables to predict reliance on an expert outside the store for energy management decisions in the two-stage least squares procedure. These variables were highly significant in the analysis of adoption of this practice, as reported in Table 5.2.

Table 6.1. Regression Results for Energy Cost per Square Foot of Selling Area

	2SLS Model including Expert Energy Management			OLS Model excluding Expert Energy Management		
	Number of obs.	152		Number of obs.	152	
	F(9, 141)	18.20		F(9, 142)	23.59	
	Prob > F	0.0000		Prob > F	0.0000	
	R-squared	0.5854		R-squared	0.6230	
	Root MSE	0.3310		Root MSE	0.3145	
	Coef.	**Robust Std. Err.**	**t**	**Coef.**	**Robust Std. Err.**	**t**
FORMAT						
• **Upscale**	0.22230**	0.13379	1.661	0.24037**	0.12000	2.003
• **Food/Drug Combination**	0.17746	0.14241	1.246	0.14099	0.12250	1.151
• **Warehouse**	0.07298	0.17399	0.419	-0.00543	0.18148	-0.030
REGION						
• **Northeast**	0.39064**	0.11658	3.351	0.36143**	0.10569	3.420
• **South**	0.15985*	0.10552	1.515	0.11439*	0.08197	1.396
• **West**	0.13831	0.10954	1.263	0.11396	0.10866	1.049
STORE CHARACTERISTICS						
• **Selling Area**	-0.25202**	0.08635	-2.918	-0.30440**	0.05921	-5.141
• **Sales per Square Foot**	0.50121**	0.10827	4.629	0.46264**	0.07938	5.828
• **Electricity Rate**	0.51317**	0.18147	2.828	0.51036**	0.17501	2.916
• **Expert Energy Management**	-0.22098	0.24955	-0.886			
CONSTANT	1.84884**	1.00571	1.838	2.42717**	0.71344	3.402

Standard errors were calculated using the Huber/White/sandwich procedure to correct for heteroskedasticity.

** Statistically significant at the 95% confidence level based on a one-tailed test.
* Statistically significant at the 90% confidence level based on a one-tailed test.

management explains over 62% of the variation. The expert energy management variable in the first model has the expected negative sign but is not statistically different from zero. Though parameter estimates for other variables in the model differ slightly for the two models, qualitative interpretations of the results are identical.

As expected, energy cost per square foot of selling area is significantly higher for upscale stores relative to conventional stores. Energy costs for food/drug combination and warehouse stores do not differ significantly from those for conventional stores. After controlling for store format and other store characteristics, energy cost is significantly higher in the Northeast and South, relative to costs in the Midwest. On the other hand, there is no significant difference between energy costs in the West and Midwest after controlling for other factors. This is generally consistent with the median energy costs per square foot of selling area presented in table 4.7 for the four regions.

Coefficients for selling area, sales per square foot, and electricity price all have the expected sign, and all are statistically significant at the 95% confidence level. Energy cost per square foot of selling area declines with increases in store size. The estimated coefficient can be interpreted as an elasticity, and the results for the model that excludes expert energy management imply that energy cost per square foot falls by approximately 3.0% when store selling area increases by 10%. The positive coefficients for sales per square foot and electricity price also can be interpreted as elasticities. Holding all other factors constant, a 10% increase sales per square foot is associated with an energy cost increase of 4.6%, and a 10% increase in electricity price is associated with an energy cost increase of 5.1%.

In interpreting these results it is important to recognize that region and electricity rate are factors that affect all stores in a local market area. Therefore, while changes in these variables affect energy cost per square foot of selling area, they are not likely to a store's competitive position. On the other hand, store format, selling area, and sales per square foot do differ across stores within a market area. Larger stores are likely to have a competitive advantage with respect to energy cost per square foot, while upscale stores and stores with higher sales per square foot (often due to greater emphasis on refrigerated and frozen products) will need to offer more services or have lower costs in other aspects of their operations to remain competitive.

7. Summary and Conclusions

Energy management costs are a significant component of overall operating costs for supermarkets. With rising energy prices and growing concerns about the reliability of energy supplies, food retailers were giving increased attention to energy management issues in 2001 when this study was conducted. In 2002 energy prices declined slightly or remained steady in most regions, and problems with shortages were largely resolved. Nevertheless, energy management will remain an important concern for supermarket operators in the years to come.

Based on survey responses from 251 stores that had previously participated in the Supermarket Panel, we found significant differences in energy management practices and techniques and in energy costs across stores grouped by ownership group size, store format, and region. Ownership group size has especially important links to adoption decisions for energy management practices and technologies that have high fixed costs and that require expertise for evaluation and effective implementation. Region affects adoption decisions through differences in energy prices and climate, but there also appear to be regional differences in the energy management "infrastructure" provided by utilities, energy consultants, and public agencies. This strong infrastructure may be a factor underlying surprisingly high adoption rates in the Midwest for some technologies. Finally store selling area and sales per square foot, which are often related to store format, are positively related to adoption of several energy management technologies.

After controlling for store format, region, and key store characteristics, we did not find any statistically significant relationship between energy cost per square foot of selling area and the adoption of energy management practices and technologies. This was a surprising result. It may be due to statistical difficulties in accurately measuring energy costs, or it may be that stores adopt energy management practices and technologies as a way to contain energy costs when they make changes in store design or product offerings that would otherwise increase energy use.

For energy suppliers and providers of energy management expertise, our results point to the characteristics of supermarkets that will be most receptive to energy management and conservation initiatives. They also suggest that adoption of energy management practices and technologies may, at best, keep supermarkets' rising demand for energy in check. Finally, the important relationship between ownership group size and the adoption of energy management practices and technologies points to a significant challenge for wholesalers. If energy costs do become an increasingly important competitive factor, wholesalers will need to develop more effective approaches to delivering energy management expertise to the independent retailers they serve.

Appendix A
Information on Base Load Calculation from *The Energy Line*[*]

Understanding Your Electricity Consumption

The importance of grocers to electric utility providers is best, demonstrated by how grocers use electricity in comparison to other customers. Typically, grocery stores are high base load customers - customers that are as important to a utility as loyal shoppers are to your store just as you stock and staff the store to address all of your loyal customers' needs, the utility obtains power to meet its customers' "peak load" the maximum amount of power a utility customer will need at any one time.

To arrive at your power needs, multiply your peak load by the total number of hours in a year (for example, 365 x 24 = 8760) and you have your "peak use," or how much power you could use. Then, divide how much power you have used in a year by peak use to obtain your "base load." The higher the base load a customer is using and paying for, the more the utility provides. The same concepts can be applied to wholesalers' operations. In the chart below, supermarkets have a 65% base load, significantly higher than residential and industrial use.

Peak Use

Customer	Peak	(8760 x peak)	Annual Use	Base Load
Residential	12.5kW	109,500kW	9,000kW	8.2%
Supermarket	500kW	4,380,000kW	3,500,000kW	65%
Industrial	2000kW	17520000kW	10,000,000kW	57.1%

Base Load equals annual consumption divided by peak use.
1 Kilowatt (kW) = 1000 Watts = 1 Hairdryer or (1) 100-Watt Bulbs r (3) 4-ft. fluorescent.
1 Megawatt (MW) = 1000 kW
The chart assumes air conditioning and other typical energy loads, but not electric heating. Actual energy use and cost depends on location, operating hours, utility rate and size of building

Source: William Poppert, Technology North

[*] Excerpted from "Understanding Your Electricity Consumption" by Jon Seltzer, published in *The Energy Line*, National Grocer's Association, Alexandria, VA, August 1998. The complete text is available at http://foodindustrycenter.umn.edu/Jon.

Appendix B

Energy Management Survey Instrument

The 2001 Supermarket Panel

Energy Management Survey

Thank you for your participation in this survey. Please provide the most accurate answers possible. See the glossary at the end of the survey for definitions of technical terms. IF YOU OWN OR MANAGE MORE THAN ONE STORE, please complete this from the perspective of the store to which it was mailed.

Please return the completed survey to:
The Food Industry Center
Minnesota Survey for Survey Research
University of Minnesota
2331 University Ave. SE, Suite 141
Minneapolis, MN 55414

Q1. Who has primary responsibility for your store's energy management? *(Circle One)*

1. Owner/ Manager
2. Corporate or regional specialist
3. Out-sourced to an energy professional affiliated with your wholesaler.
4. Out-sourced to an independent energy professional.
5. A representative of my mechanical, electrical or refrigeration contractor.
6. Don't Know

Q2. Do you have a formal energy management program? *(Circle One)*

1. Yes
2. No
3. Don't Know

Q3. When were the following features installed in your store? *(Circle ONE answer for each item.)*

Energy Management Feature	Originally Built-In	Added 1999 or later	Added before 1999	Not in the Store	Don't Know
a. T-8 lighting	1	2	3	4	5
b. Other energy efficient lighting	1	2	3	4	5
c. Outdoor high pressure sodium lighting	1	2	3	4	5
d. Refrigeration improvement	1	2	3	4	5
e. Heat recovery from HVAC	1	2	3	4	5
f. Heat recovery from refrigeration	1	2	3	4	5
g. Building automation/EMS to control HVAC	1	2	3	4	5
h. Load shedding	1	2	3	4	5
i. Demand controllers	1	2	3	4	5

Q4. How regularly do you do the following? *(Circle ONE answer for each item.)*

Energy Management Practice	Always	Most of the Time	Seldom	Don't Know
a. Change air filters every 60 days	1	2	3	4
b. Temp control inspection and calibration every 180 days	1	2	3	4
c. Professional check-up and maintenance for HVAC and refrigeration every 180 days	1	2	3	4

Q5. How much on-site generation capacity do you have? *(Circle One)*

1. None
2. Sufficient to shutdown the Front end and for customers to exit the store (life safety needs).
3. Ability to keep operating at a reduced level for at least 60 minutes
4. Ability to operate at 75% for at least 3 hours without fear of "losing" product

Q6. How many hours in the past year has your store been without power?

______________ (if none please enter 0)

____Don't Know

Q7. How concerned are you about electric reliability in the future? *(Circle One)*

1. Very concerned
2. Somewhat concerned
3. Not very concerned
4. Not at all concerned

Q8. On average, how much energy are you using per year in your store?

	Gas	Electric	Total
a. Dollars per year	_______	_______	_______
b. % of sales	_______	_______	_______
c. Cubic ft./ Kilowatt Hrs.	_______	_______	XXXXXX

Q9. How is your energy use pattern changing relative to past years? *(Circle ONE answer for each energy type.)*

Energy Type	Declining	No Change	Increasing	Don't Know
a. Gas	1	2	3	4
b. Electricity	1	2	3	4

Q10. How do you track real-time energy use? *(Circle One)*

1. Readings from store building automation/ EMS.
2. Record bills/ invoices from your utility
3. Third-party off-site energy monitoring service
4. Don't track real-time energy use
5. Don't Know

Q11. What are the energy "rates"/ or price delivered to your store? *(Fill in a rate or circle "Don't Know")*

a. Gas	$ __________	per Cubic Foot	Don't Know
b. Electricity	$ __________	per Kilowatt Hour	Don't Know

Q12. Has electricity been deregulated in your marketplace? *(Circle ONE. If 3, fill in the year.)*

1. Yes →
2. No
3. It will be in ________ (year)
4. Don't Know

IF YES: Has your store purchased electricity from a supplier other than your traditional utility?

1. YES
2. NO
3. Don't know

Q13. Would you be willing to pay a 5% premium for Green or renewable energy? *(Circle ONE.)*

1. Yes
2. No
3. Don't Know

Glossary

Demand Controllers – Devices that measure how much electricity a store is using to prevent certain pieces of equipment from coming on at the same time. This spreads energy use out over the course of the day.

Deregulation – The opportunity to purchase power from multiple sources of supply rather than a single supplier.

EMS – Energy Management System, or Building Automation System, that monitors energy usage, shuts off unneeded lighting, heat or refrigeration.

Energy Management Program – A plan that integrates sales, energy usage and maintenance to make sure you are using power only when needed and in a cost effective manner.

Green/ Renewable Power – Power generated from renewable sources such as wind, solar and hydro versus coal and natural gas.

Heat Recovery – Capturing heat from one system, such as refrigeration or air conditioning to use in water or space heating.

HVAC – The store's Heating Ventilation and Air Conditioning system.

Load Shedding – Under an agreement with the energy provider (utility) the store is temporarily switched over to its own generator(s) as a source of power. The process is usually initiated by a telephone call from the energy provider to alert the store that there is an opportunity for load shedding.

T-8 Lighting – New high efficiency fluorescent lights, as opposed to T-12's.

CONSENT FORM
2001 SUPERMARKET PANEL ENERGY MANAGEMENT SURVEY
UNIVERSITY OF MINNESOTA

As a member of the 2001 Supermarket Panel, your store is invited to participate in the Energy Management Survey conducted by the Food Industry Center at the University of Minnesota. Your store will be one of several hundred stores to participate in the gathering of this information.

Purpose: Collect information on energy management practices and costs in supermarkets.

Procedure: When you return the survey form to our data collection center, your data will be coded with your store ID as the only unique identifier. The University of Minnesota Center for Survey Research will maintain a master list that matches stores to store IDs. That list will be used to manage Panel mailings and to prepare and distribute benchmark reports.

We will provide you with a benchmark report about how your store compares to your peer stores as soon as possible after the data is returned. Please record the store ID printed on the front cover of this booklet. Should you have questions about the survey or your benchmark report, you can provide this ID to allow us to locate the data for your store.

Confidentiality: The records in this study will be kept private. It will not be possible to identify a specific store, company, ad group or city from any report or presentation based on the survey data.

Returning the completed data sheets constitutes your consent to participate in this survey.

The services of the Food Industry Center are available to you at all times, independent of your decision to participate in this survey. We appreciate your interest in the Center and hope you will choose to participate in this project.

Your decision whether or not to participate in this survey will not affect your current or future relations with the University or the Center. If you decide to participate, you are free to withdraw at any time without affecting those relationships.

Please direct all questions pertaining to the 2001 Supermarket Panel to:

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