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Energy and Rental Housing

A Wisconsin characterization study: Appendices

April 2005

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TABLE OF CONTENTS

Appendix A: Sampling 1

 Sample design 1

 Weighting 5

 Unit Weights 9

Appendix B: Classification of Low-income tenants and buildings 11

 Classification of tenant survey respondents as low-income 11

 Classification of buildings as predominantly low-income 12

Appendix C: analysis of utility usage histories 17

 Weather Normalization 18

 Weather Data 20

Appendix D: Energy efficiency opportunity definitions and calculation methods 21

Appendix E: Analysis of refrigerator monitoring data 31

 Refrigerator monitoring data analysis 31

Appendix F: Data Collection Instruments 35

APPENDIX A: SAMPLING

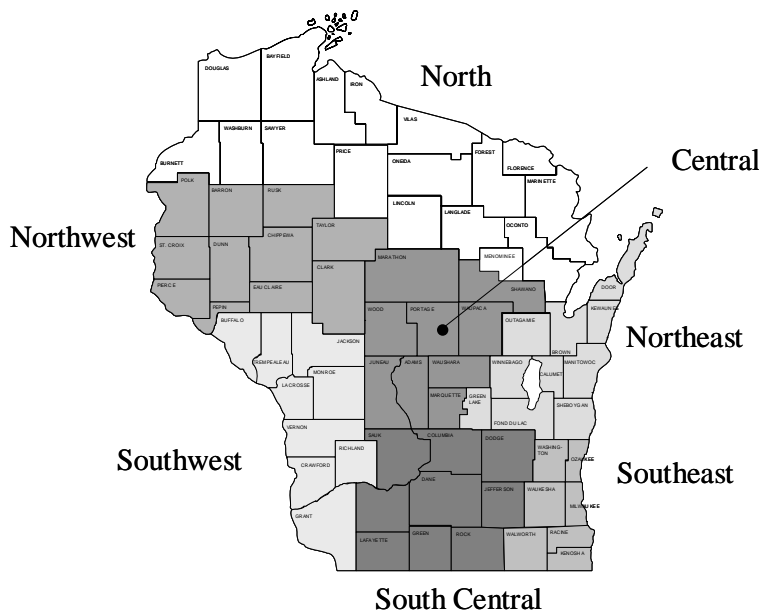
SAMPLE DESIGN

The goal of the sampling was to provide a statistically representative random sample of 180 rental buildings in Wisconsin. We first stratified the total target sample into seven approximately equal strata by building size. These were meant to ensure coverage of all building sizes, and were not meant to be proportional to the actual occurrence of buildings in the population. (We developed case weights to appropriately weight across strata). We then apportioned the target sample for each size stratum geographically (Figure 1). This was done in approximate proportion to the (estimated) population of buildings in each region. Table 1 shows the resulting target sample by building size stratum and region.

TABLE 1. SAMPLE TARGETS BY REGION AND BUILDING SIZE

	DWELLING UNITS IN STRUCTURE							TOTAL
	1	2	3-4	5-9	10-19	20-49	50+	
Southeast	8	12	11	11	11	13	14	80
South Central	6	3	5	6	6	6	5	37
Northeast	4	5	4	4	4	3	3	27
Northwest	3	1	2	2	1	1	1	11
Southwest	3	1	1	1	1	1	1	9
Central	3	1	1	1	1	1	1	9
North	3	2	1	0	1	0	0	7
Total	30	25	25	25	25	25	25	180

FIGURE 1. GEOGRAPHIC REGIONS FOR SAMPLING



Recruiting was done using two types of sources: (1) rental properties identified during the course of implementing several random-digit-dial telephone surveys conducted between 1999 and 2001; and (2) properties sampled from tax roll records for communities that were themselves sampled for the project.

RDD SURVEY SAMPLE

In anticipation of the study, the Energy Center attempted to elicit property address and landlord contact information whenever renters were encountered during large-scale, residential, random-digit-dial (RDD) telephone surveys in the years leading up to this study. Several such surveys were included in this effort:

1. Recruiting effort for the Residential Characterization Study (February – May 1999)
2. 1999 Appliance Sales Tracking (AST) Survey (July 1999)
3. 2001 AST Survey (August 2001)

The AST surveys were statewide RDD surveys. The Residential Characterization Study used a two-stage sampling scheme, in which counties were first sampled from within eight population-size strata, and then RDD recruiting was conducted within sampled counties.

Table 2 below shows the disposition of these efforts. Overall, about one in five tenants contacted were willing to provide the address of the property, and of these, the majority (81%) provided some contact information for the landlord.

TABLE 2. RESULTS OF THREE RDD EFFORTS TO IDENTIFY RENTAL PROPERTIES AND LANDLORD CONTACT INFORMATION

	RES. CHAR.	1999 AST	2001 AST	TOTAL
Tenants Contacted	478	603	560	1641
Provided building address				
N	99	121	90	310
%	21%	20%	16%	19%

Combined disposition of landlord information for contacts with building address

		Landlord Telephone #		Total
		No	Yes	
Landlord Address	No	57	52	109
	Yes	79	122	201
Total		136	174	310

In addition to this pool of properties, the Energy Center also conducted a rental sector pilot study in 1998 that involved a similar effort to identify rental properties via RDD contact with tenants. Tenant respondents completed a telephone survey and were asked to provide property and landlord contact information similar to the efforts above. The study contractor then attempted to contact these landlords and complete a property owner/manager telephone survey. A total of 282 tenant responses and 78 property owner/manager responses were obtained. Sixty three of the property owner/managers contacted stated they were willing to be contacted again in the future. These contacts were also used to recruit for the current study.

For the most part, properties identified from these sources can be considered to be sampled with probability proportional to size (PPS). That is, any particular dwelling unit in the state has an equal chance of being sampled for the study.

SUPPLEMENTARY SAMPLE — PROPERTY TAX ROLLS

Though desirable from a random sampling standpoint, the RDD samples did not contain enough properties to fill the study targets. We therefore sought to obtain supplementary listings of Wisconsin properties from which to recruit for the study. After considering a number of approaches, we decided that obtaining property tax roll data from selected Wisconsin communities would best meet the needs and budget for the project. We therefore sampled Wisconsin cities and towns within each of our geographic regions and sought to obtain property tax information that could be used to identify rental properties for recruiting into the study.

To maintain a PPS cast to the sampling, we sampled the communities themselves with probability proportional to size; that is, we obtained Census data on Wisconsin cities and towns, and sampled these communities such that the probability of a given community being selected was proportional to the number of rental housing units in the community.¹

The sample communities are shown in Table 3. We then attempted to obtain property tax records for these communities. We were not able to do so within the time frame of the study for a number of the communities, and rental properties could only be identified for multifamily buildings for some communities.

In addition, not all landlords and sampled tenants returned questionnaires. Table 4 shows the number of completed questionnaires by building size stratum.

We attempted to obtain a completed owner/manager questionnaire from all participants in the study, but some landlords did not return the survey despite repeated requests. The final data set includes 161 completed questionnaires, for a response rate of 89 percent.

Except for the largest buildings, we delivered tenant questionnaires to the door of all tenants in each sampled building. In buildings with more than 50 units, a random sample of 20 tenants received a questionnaire. We received 748 out of 1,613 tenant questionnaires back, for a completion rate of 46 percent.

¹ There is a small amount of sample frame error in this approach. A small proportion of rental housing units (~10%) are in rural areas not listed within any city or town.

TABLE 3. SUPPLEMENTARY COMMUNITIES

REGION	SAMPLED CITY/TOWN/VILLAGE	COUNTY	RENTAL HOUSING UNITS (2000)	SAMPLE OBTAINED?
Southeast	Milwaukee city	Milwaukee	126,953	Yes
	Racine city	Racine	12,477	Yes
	Greendale village	Milwaukee	1,820	No
South Central	Madison city	Dane	46,523	Yes
	Beloit city	Rock	5,093	Yes
	Johnson Creek village	Jefferson	208	No
Northeast	Green Bay city	Brown	18,310	No
	Oshkosh city	Winnebago	10,231	No
	Manitowoc city	Manitowoc	4,609	No
Southwest	La Crosse city	La Crosse	10,364	Yes (4+ units only)
	Platteville city	Grant	1,588	No
	Dickeyville village	Grant	121	No
Northwest	Eau Claire city	Eau Claire	10,257	Yes
	Menomonie city	Dunn	2,878	No
	Bruce village	Rusk	128	No
Central	Wausau city	Marathon	6,002	Yes (1-3 units only)
	Stevens Point city	Portage	4,436	No
	Mauston city	Juneau	601	No
North	Superior city	Douglas	4,450	
	Marinette city	Marinette	1,610	Yes (4+ units only)

TABLE 4. FINAL DATA SET SIZES FOR ON-SITE AND SURVEY DATA COLLECTION.

UNITS IN BUILDING	BUILDINGS WITH ON-SITE DATA COLLECTION	COMPLETED OWNER/MANAGER QUESTIONNAIRES	COMPLETED TENANT QUESTIONNAIRES
1 unit	29	27	11
2 units	25	22	23
3-4 units	24	23	53
5-9 units	29	27	86
10-19 units	27	22	140
20-49 units	26	25	258
50+ units	20	15	177
Total	180	161	748

Weighting

Table 5 and Table 6 show how the population and sample housing units are distributed across the 49 strata for the study (seven building size strata by seven geographic strata). By targeting a roughly equal number of buildings in each size stratum, the sampling plan for the study effectively over-sampled larger buildings in order to obtain meaningful sample sizes for these size categories. The plan attempted to sample proportionately to geographic distribution, but recruiting efforts were only partly successful in this regard.

There are also 12 strata with no sample points (Table 7). Each of these strata—representing about 11 percent of the rental population in all—were combined with another strata for the same building size in a different geographic region that had sample representation, effectively reducing the number of strata in the study from 49 to 37.

TABLE 5. RENTAL HOUSING UNIT POPULATION DISTRIBUTION, CELL PROPORTIONS BY STRATUM

REGION	BUILDING SIZE STRATUM (# UNITS IN BUILDING)							TOTAL
	1	2	3-4	5-9	10-19	20-49	50+	
Central	2.7%	1.2%	0.6%	0.8%	0.5%	0.4%	0.3%	6.5%
North	2.3%	0.7%	0.5%	0.4%	0.3%	0.2%	0.2%	4.6%
Northeast	4.0%	3.8%	1.6%	2.5%	1.7%	1.2%	1.0%	15.7%
Northwest	2.4%	1.1%	1.0%	0.9%	0.5%	0.6%	0.3%	6.7%
South Central	4.5%	2.8%	2.4%	2.9%	2.3%	2.7%	1.5%	19.0%
Southeast	8.1%	9.4%	4.9%	5.8%	4.1%	5.1%	4.8%	42.2%
Southwest	2.0%	1.0%	0.6%	0.6%	0.5%	0.4%	0.3%	5.3%
Total	26.0%	20.0%	11.4%	13.7%	9.9%	10.6%	8.4%	100.0%

Source: Census 2000 Summary File 3, occupied housing units.

Total housing units: 657,884

TABLE 6. STUDY SAMPLE HOUSING UNIT DISTRIBUTION, CELL PROPORTIONS BY STRATUM

REGION	BUILDING SIZE STRATUM (# UNITS IN BUILDING)							TOTAL
	1	2	3-4	5-9	10-19	20-49	50+	
Central	0.1%	0.1%	no sample	0.2%	no sample	0.8%	no sample	1.2%
North	no sample	0.1%	0.2%	0.4%	0.8%	no sample	no sample	1.6%
Northeast	0.1%	0.1%	0.4%	no sample	1.2%	1.2%	no sample	3.0%
Northwest	0.1%	0.2%	0.1%	no sample	0.7%	1.5%	no sample	2.5%
South Central	0.3%	0.4%	0.6%	0.8%	1.1%	7.7%	22.6%	33.6%
Southeast	0.3%	0.6%	1.0%	4.4%	5.2%	10.8%	32.4%	54.7%
Southwest	no sample	0.1%	0.2%	0.1%	1.0%	no sample	2.2%	3.7%
Total	0.8%	1.4%	2.6%	6.0%	10.0%	22.0%	57.2%	100.0%

Total housing units: 3,604

TABLE 7. REALLOCATION OF STRATA WITH NO SAMPLE

REGION	SIZE CATEGORY	PERCENT OF POPULATION	REALLOCATED TO REGION...
North	1 unit	2.3%	Northwest
Southwest	1 unit	2.0%	South Central
Central	3-4 units	0.6%	South Central
Northwest	5-9 units	0.9%	Southwest
Northeast	5-9 units	2.5%	Central
Central	10-19 units	0.5%	South Central
North	20-49 units	0.2%	Northwest
Southwest	20-49 units	0.4%	South Central
Central	50+ units	0.3%	South Central
North	50+ units	0.2%	South Central
Northeast	50+ units	1.0%	South Central
Northwest	50+ units	0.3%	Southwest
Total		11.2%	

Building Weights

As noted previously, sampling was done largely with probability proportional to size (PPS), where size is number of housing units. This means that larger buildings are more likely to be sampled than smaller buildings. It can be demonstrated that with PPS sampling, the building weight (i.e. the number of buildings in the population represented by each building in the sample) for each sampled building is:

$$\text{Building weight} = (\text{total units in stratum population}) / [(\text{units in sampled building}) * (\text{\# buildings in stratum sample})]$$

Note that the Census data used for the population figures are occupied housing units, but the sample housing units are all housing units in each sampled building. Reliable data on vacancies in the sampled buildings were not consistently obtained, and it is not possible to unambiguously classify Census counts

of vacant housing units between rental and owner-occupied. Unless vacancy rates are relatively high—and differ significantly by region—this approach should not lead to significant error in the weights.

For convenience sake, the calculated building weights were rounded to the nearest integer, and then manipulated manually slightly so that the weights would reflect a statewide total of exactly 658,000 housing units.²

As Table 8 shows, the calculated building weights range over about three orders of magnitude, from about 14 to more than 15,000. The vast majority of this variation is across strata: large stratum weights are all associated with smaller properties, and small weights are associated with larger properties.

Also of interest is the variation in building weights within reporting category. For reporting purposes, the number of building-size categories is reduced to four. Table 9 shows the mean, minimum, and maximum building weight for each of these size categories.

² Different Census 2000 tables variously give the total number of occupied rental housing units in Wisconsin as either 657,884 or 658,083.

TABLE 8. HOUSING UNITS, BUILDINGS, AND BUILDING WEIGHTS, BY STRATUM

STRATUM		HOUSING UNITS IN SAMPLE	BUILDINGS IN SAMPLE	BUILDING WEIGHT (OR RANGE) ^a
REGION	UNITS IN BUILDING			
Central	1	3	3	5,851
Northeast	1	3	3	8,665
Northwest	1	2	2	15,574-15,775
South Central	1	10	10	4,273
Southeast	1	11	11	4,849
Central	2	2	1	4,080
North	2	2	1	2,191
Northeast	2	2	1	12,634
Northwest	2	6	3	1,203
South Central	2	14	7	1,302
Southeast	2	20	10	3,102
Southwest	2	4	2	1,585
North	3-4	8	2	379
Northeast	3-4	16	4	645
Northwest	3-4	4	1	1,580
South Central	3-4	23	6	818-1,090
Southeast	3-4	33	9	893-1,191
Southwest	3-4	8	2	467
Central	5-9	8	1	2,676
North	5-9	16	2	170
South Central	5-9	29	4	589-942
Southeast	5-9	158	21	200-361
Southwest	5-9	5	1	1,920
North	10-19	28	2	72-83
Northeast	10-19	44	3	233-311
Northwest	10-19	26	2	102-163
South Central	10-19	41	3	385-559
Southeast	10-19	188	14	120-193
Southwest	10-19	36	3	77-108
Central	20-49	29	1	83
Northeast	20-49	44	2	172-189
Northwest	20-49	53	2	81-134
South Central	20-49	278	8	59-105
Southeast	20-49	389	13	66-129
South Central	50+	815	7	18-61
Southeast	50+	1,167	12	14-47
Southwest	50+	79	1	24
Total		3,604	180	

^aStrata with only one building weight are those where all sampled buildings have the same number of units. Strata with a range of building weights have sampled buildings that vary in the number of units, and hence have varying building weights.

TABLE 9. BUILDING WEIGHTS BY REPORTING GROUP

GROUP (UNITS IN BUILDING)	SAMPLED BUILDINGS	AVERAGE	MINIMUM	MAXIMUM
1 unit	29	5,902	4273	15,775
2-4 units	49	1,751	379	12,634
5-19 units	56	317	72	2,676
20+ units	46	67	14	189

Unit Weights

While the building weights are appropriate for building-level data, other data were collected at the housing unit level (e.g., the tenant survey and the in-unit data from the site visits). For these data, apartments were sampled within buildings at proportions that varied across the strata, as Table 10 shows.

TABLE 10. NUMBER OF APARTMENTS SAMPLED, BY BUILDING SIZE

NUMBER OF UNITS IN BUILDING	PHYSICAL DATA	
	COLLECTION	TENANT SURVEY
Single family	1	1
2-4 units	2	all units
5-9 units	2	all units
10-19 units	3	all units
20+ units	4	20 units

To account for different sampling rates at the unit level, unit weights are calculated as follows:

$$\text{Unit weight} = \text{building weight} * (\text{total units in building} / \text{sampled units in building})$$

As with the building weights, the unit weights reflect the number of dwelling units in the population represented by each dwelling unit in the sample. These weights were also rounded to the nearest integer, and manipulated to reflect a rental housing unit population of 658,000.

Separate unit weights were calculated for the tenant survey responses and the in-unit on-site data, since these were sampled at different rates in many cases.

APPENDIX B: CLASSIFICATION OF LOW-INCOME TENANTS AND BUILDINGS

The determination of low-income status was based on a combination of tenant and landlord questionnaire responses. This was done at two levels: (1) individual tenants were classified as low-income if their questionnaire responses indicated that their income was below 150 percent of the federal poverty guideline; and (2) buildings were classified as predominantly low-income if the available data suggested that 50 percent or more of tenants in the building could be classified as low-income. These two determinations are described in more detail below.

CLASSIFICATION OF TENANT SURVEY RESPONDENTS AS LOW-INCOME

The combination of self-reported number of household members (Q66e) and 2001 total income (Q70) was used to classify respondents as either above or below 150 percent of the 2001 federal poverty guideline.³ Though income was reported in ranges, in most cases the low-income classification could be made unambiguously. For example, 150 percent of the federal poverty guideline for a family of four is \$26,475. Respondents who reported a household size of four members were assigned low-income status based on their response to the income questions as shown in Table 11.

TABLE 11, LOW INCOME CLASSIFICATION FOR A FAMILY OF FOUR

REPORTED INCOME RANGE (Q70)	LOW-INCOME?
Less than \$5,000	Yes
\$5,000 to \$9,999	Yes
\$10,000 to \$14,999	Yes
\$15,000 to \$19,999	Yes
\$20,000 to \$24,499	Yes
\$25,000 to \$29,999	Ambiguous
\$30,000 to \$34,999	No
\$35,000 to \$49,999	No
\$50,000 to \$74,999	No
\$75,000 or more	No

A total of 584 respondents (78%) were classified as either low-income or not low-income in this manner.

Respondents whose household size and reported income range left their low-income status ambiguous were assigned a random income within the reported range, and low-income status was imputed from this value. To continue the above example, if a family of four reported an income range of \$25,000 to \$29,999, a random value in this range was generated and compared against the threshold level of \$26,475. If the imputed income was above the threshold, the household was

³ The 2001 federal poverty guideline is defined as an annual income of \$8,590 for the first household member, plus \$3,020 for each additional household member.

classified as not low-income; if the value was at or below the threshold, the household was classified as low-income. A total of 105 respondents (14%) were classified as either low-income or not low-income using imputed income within an ambiguous range.

Overall, 59 respondents (8%) did not provide sufficient information to assign a low-income status.

Table 12 below compares the proportion of tenant households classified as low-income from the current study with results obtained from a large-scale, statewide telephone survey conducted every other year by the Energy Center of Wisconsin, known as the Appliance Sales Tracking (AST) survey. The data are in reasonable agreement, except for cases where the sample size is small. Most notably, the small number of respondents in single-family buildings has a very high percentage of low-income tenants. Because these households represent more than a quarter of all rental households, this result affects the calculated overall percentage as well—and provides additional justification for excluding single-family respondents from analyses involving the tenant survey data. The calculated overall low-income incidence rate for 2+ unit housing, on the other hand, is in good agreement across the three data sets.

TABLE 12. COMPARISON OF STUDY AND APPLIANCE SALES TRACKING SURVEY INCIDENCE OF LOW INCOME HOUSEHOLDS

UNITS IN BLDG	% OF ALL TENANTS ^a	PERCENT OF TENANT HOUSEHOLDS THAT ARE AT OR BELOW 150% OF THE FEDERAL POVERTY GUIDELINE			SAMPLE SIZE		
		AST 2001	AST 2003	STUDY	AST 2001	AST 2003	STUDY
1	26%	30%	40%	63%	162	180	10
2-4	31%	34%	38%	40%	187	190	70
5-9	14%	45%	39%	30%	31	70	79
10-19	10%	19%	32%	28%	27	47	132
20-49	11%	29%	25%	40%	14	40	233
50+	8%	27%	38%	37%	15	39	165
Overall ^a	100%	32%	37%	43%	436	566	689
2+ units ^a		32%	36%	36%	274	386	679
		non-response rate:			18%	8%	8%

^aWeighted to Census 2000 proportions by number of units in structure.

CLASSIFICATION OF BUILDINGS AS PREDOMINANTLY LOW-INCOME.

It was also of interest to classify buildings in the study as either predominantly occupied by low-income tenants or not. For the purposes of this study, a building was classified as predominantly low-income if 50 percent or more of the tenant households in the building had annual income at or below 150 percent of the federal poverty guideline, and the building was not also classified as being predominantly student occupied.

We first identified buildings in the study that were predominantly student occupied, since while students may qualify as low-income, they are often dependents. This classification was made on the basis of the landlord responses to a survey question (A5) about the percentage of student, low-income and elderly tenants in the sampled building. We also made use of tenant responses to questions about level of education and whether the household could be considered unrelated adults living as roommates. Finally, we also considered the location of the building, considering that student housing should be near a known college campus. The analysis resulted in identifying 22 buildings as predominantly student occupied. These buildings were removed from further consideration as low-income properties.

We then employed the following protocol to classify the remaining 158 buildings as predominantly low-income or not:

1. **Unambiguous classification based on tenant survey respondents.** If the number of tenant survey respondents in a building was sufficient to determine whether a majority of tenants in the building were low-income, the building was classified on this basis. For example, if there were four or more tenant respondents in an eight-unit building, the building could be unambiguously classified as either predominantly low-income or not based solely on the tenant responses. Nineteen buildings (12%) were classified in this way; most of these were smaller buildings.
2. **High probability classification based on tenant survey responses.** In many cases, the number of tenant survey respondents did not meet the threshold to unambiguously classify a building as either predominantly low-income or not, but the tenant survey results strongly indicated a classification. For example, one 33-unit building in the study had 15 tenant survey respondents, 11 of which (73%) were classified as low-income. Buildings like this were classified based on the tenant survey data if it could be demonstrated that the probability of a false classification was 10 percent or less. Formally, this was done by first finding the number of building tenants that would just swing the classification opposite to the result indicated from the tenant survey data, then calculating the probability of obtaining a survey result as extreme (or more) than the one observed. To continue the above example with the 33-unit building, the tenant survey data suggest a predominantly low-income building. The *most* low-income tenants the building could have to be classified as *not* predominantly low-income is 16 (48%). If the building has 16 low-income tenants out of 33 total, then the probability of obtaining 11 or more low-income survey respondents out of 15 can be calculated: it is about 1 percent. Thus it seems reasonable to classify the building as predominantly low-income in this case. Forty three buildings (27%) were assigned a low-income classification in this way.
3. **Classification based on owner/manager survey response.** In cases where the tenant survey data did not allow unambiguous or high-probability classification of the building, the owner/manager survey data was used. Buildings were classified as predominantly low-income if the owner/manager indicated that 50 percent or more of the building's units were occupied by low-income tenants. Though the owner/manager questionnaire did not provide any detailed definition of "low-income," comparison of the tenant-survey data and the owner/manager-survey data showed good agreement—once an additional

step described below was undertaken. Most (90%) buildings that were classified as not being predominantly low-income based on the tenant survey data were also categorized thus by the owner/manager respondent. However, the survey data also showed that about half of buildings classified as low-income based on the tenant data were not so classified by the owner/manager respondent. Further analysis showed that about a quarter of these cases were buildings for which the owner/manager respondent indicated a high percentage of student tenants. Overall, 76 buildings (48%) were classified based on the owner/manager survey data.

4. **Low confidence classification based on tenant survey responses.** The three preceding approaches allowed classification of 138 (87%) of the non-student housing in the study. Eleven buildings that could not be classified in the above manner still had tenant survey data—though in each case these were insufficient to ensure at least 90 percent confidence in a correct classification. These buildings were classified based on the available tenant data, despite the fact that this could not be done with high confidence. The list of buildings and tenant data is shown in Table 13 below.

TABLE 13. LOW CONFIDENCE LOW INCOME DETERMINATIONS

BUILDING ID	UNITS IN BUILDING	LOW-INCOME TENANTS	
		OUT OF ALL TENANT RESPONDENTS	CLASSIFIED AS LOW-INCOME BUILDING?
471	6	1 out of 2	Yes
164	8	1 out of 4	No
183	8	1 out of 3	No
491	10	2 out of 3	Yes
829	10	3 out of 5	Yes
209	14	4 out of 8	Yes
534	16	2 out of 5	No
677	42	1 out of 3	No
906	65	1 out of 4	No
903	108	1 out of 5	No
1222	160	5 out of 12	No

5. **Unable to classify.** Nine buildings had insufficient data for classification by any means; these were all buildings with nine or fewer units.

Table 14 shows the (weighted) distribution of how the (non-student) buildings were classified by building size. The second table shows the percent classified as predominantly low-income based

on the classification scheme described above (with buildings that were not capable of being classified excluded, and student housing classified as non-low income).

TABLE 14. CLASSIFICATION METHOD, BY BUILDING SIZE

	HIGH PROBABILITY			LOW CONFIDENCE		TOTAL
	UNAMBIGUOUS TENANT DATA	TENANT DATA	OWNER/MGR DATA	TENANT DATA	UNABLE TO CLASSIFY	
1 unit	40%	0%	48%	0%	12%	100%
2 units	28%	0%	57%	0%	15%	100%
3-4 units	7%	9%	84%	0%	0%	100%
5-9 units	2%	51%	36%	7%	4%	100%
10-19 units	0%	47%	40%	13%	0%	100%
20-49 units	6%	57%	35%	2%	0%	100%
50+ units	0%	62%	21%	17%	0%	100%
Overall (weighted)	32%	4%	52%	1%	11%	100%

TABLE 15. INCIDENCE OF LOW INCOME BUILDINGS, BY BUILDING SIZE

UNITS IN BUILDING	PERCENT OF BUILDINGS CLASSIFIED AS PREDOMINANTLY LOW-INCOME
1 unit	42%
2 units	38%
3-4 units	25%
5-9 units	13%
10-19 units	16%
20-49 units	23%
50+ units	15%
Overall (weighted)	37%

APPENDIX C: ANALYSIS OF UTILITY USAGE HISTORIES

We attempted to obtain both tenant and master-metered electricity and natural gas consumption data for as many accounts as possible for each building in the study. The tenant questionnaire included a utility fuel release form for respondents to return to us to allow us to obtain tenant data from the local utility. We also requested permission from landlords to obtain data on master-metered accounts. However, some landlords did not provide such permission, and not all tenants responded to the tenant survey.⁴ This left a number of buildings with missing master metered or tenant data, as Table 16 shows.

TABLE 16. UTILITY DATA RECOVERY (BUILDING COUNTS)

	UNITS IN BUILDING				OVERALL
	1	2-4	5-19	20+	
Master-metered					
Gas					
Not Present	28	33	19	8	88
Obtained	0	12	18	28	58
Missing	1	4	19	10	34
Electricity					
Not Present	28	34	19	4	85
Obtained	0	14	31	32	77
Missing	1	1	6	10	18
Tenant-metered^a					
Gas					
Not Present	3	10	32	38	83
Obtained	12	29	14	6	61
Missing	14	10	10	2	36
Electricity					
Not Present	1	2	2	6	11
Obtained	12	32	44	38	126
Missing	16	15	10	2	43
Total buildings in sample	29	49	56	46	180

^a "Obtained" defined as obtaining at least one tenant account in the building.

⁴ One utility (Madison Gas and Electric) provided consumption histories for all accounts in the sampled building.

The number of usable accounts is shown in Table 17.

TABLE 17. USABLE ELECTRICITY AND NATURAL GAS USAGE HISTORIES

	Tenant-metered	Master-metered	Total
Gas	247	62	309
Electricity	1,390	83	1,473
Total	1,637	145	1,782

Weather Normalization

We used the Princeton Scorekeeping Method (PRISM) to perform two important functions: (1) separate weather-sensitive space heating and air conditioning use from the overall gas or electricity use; and (2) adjust these uses to typical weather conditions.

Given a monthly usage history and a database of daily outdoor temperatures, the PRISM software that we used (Advanced Version 1.0) can statistically fit any of three models to the data:

1. heating-only model— Use per day = $\alpha + \beta_h h_h(\tau_h)$
2. cooling-only model— Use per day = $\alpha + \beta_c h_c(\tau_c)$
3. heating and cooling model — Use per day = $\alpha + \beta_h h_h(\tau_h) + h_c(\beta_c \tau_c)$

where,

α = non-weather sensitive (or base) use per day

$\beta_{h,c}$ = use per heating or cooling degree day

$h_{h,c}$ = heating or cooling degree days per day from base temperature τ , which are calculated from daily average outdoor temperatures (T_{avg}) as:

$$H_h = \max(\tau_h - T_{avg}, 0)$$

$$H_c = \max(T_{avg} - \tau_c, 0)$$

and then averaged over the consumption period

$\tau_{h,c}$ = base temperature for calculating heating or cooling degree days

We based the model choice on the on-site data of end-uses and fuels. Model 1 (heating only) is appropriate for analyzing gas usage for usage that includes gas space heat. Model 2 (cooling only) would be appropriate for analyzing electricity usage that includes air conditioning, but no electric space heat. And Model 3 is appropriate for analyzing accounts with electric space heat and air conditioning. The α , β , and τ coefficients are fit individually to each house using a modified least-squares approach that allows the non-linear τ to be optimized.

In some cases, the τ parameter is poorly determined from the data, usually because there are too few data points. In these cases, we substituted fixed- τ models, with the τ 's fixed at values that were typical of the cases with reasonable values for τ .

There were also cases where the heating and cooling coefficients ($\beta_{h,c}$) were negative. These generally represented cases where the model was inappropriately specified (e.g., a heating and cooling model for a household that did not use their air conditioning). In these cases, we switched to a different model.

Once the appropriate model is fit to the data, weather normalized annual use for each component can be calculated as:

$$\text{normalized annual base consumption (Base)} = 365.25 * \alpha$$

$$\text{normalized annual heating consumption (NAHC)} = \beta_h H_{oh}(\tau_h)$$

$$\text{normalized annual cooling consumption (NACC)} = \beta_c H_{oc}(\tau_c)$$

and

$$\text{normalized annual consumption (NAC)} = \text{Base} + \text{NAHC} + \text{NACC}$$

where

$H_{oh,c}(\tau_{h,c})$ represent long-term average annual heating or cooling degree days to base temperature τ .

For accounts without heating or cooling loads, we simply annualized the data as 365.25 times average use over the billing history, using a period as close as possible to an integer number of years of the history.

Table 18 shows the final model disposition of the usage histories.

TABLE 18. DISPOSITION OF USAGE HISTORIES

	Tenant-metered	Master-metered	Total
Gas			
Heating-only	189	37	226
Heating-only, fixed τ	3	2	5
Annualized	0	1	1
Electricity			
Heating-only	12	2	14
Heating-only, fixed τ	12	0	12
Cooling-only	879	2	881
Cooling-only, fixed τ	82	0	82
Heating + Cooling	194	1	195
Heating + Cooling, fixed τ	49	0	49
Annualized	153	77	230

Weather Data

The 180 buildings sampled for the study were located in 30 counties. These counties were assigned to one of eight weather zones that generally corresponded with the NOAA climate zones within the state. We obtained daily average temperature data for each zone. Long-term normals were based on the 20-year period from 1980 through 1999. Table 19 below shows the assignment of counties to the weather zones, along with the 20-year average heating and cooling degree days (base 65).

TABLE 19. WEATHER ZONES APPLICABLE TO EACH COUNTY

WEATHER STATION	ANNUAL HEATING DEGREE DAYS (1980-1999)	ANNUAL COOLING DEGREE DAYS (1980-1999)	COUNTIES
Rhineland	8905	304	Price
Rhineland/Green Bay average	8260	386	Marinette, Oconto
Green Bay	7762	479	Brown, Calumet, Manitowoc, Outagamie, Winnebago
Spooner	8280	453	Chippewa, Polk
Eau Claire	8274	453	Eau Claire, La Crosse
Hancock	7621	569	Juneau, Portage, Waupaca, Wood
Lancaster	7427	611	Grant, Richland
Madison	7313	612	Columbia, Dane, Dodge, Jefferson, Rock
Milwaukee	6861	680	Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, Waukesha

APPENDIX D: ENERGY EFFICIENCY OPPORTUNITY DEFINITIONS AND CALCULATION METHODS

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>
Shell Measures		
<i>Wall Insulation</i>		
Definition of opportunity	Buildings with no wall cavity insulation.	
Savings	The building is modeled using REM/Design with blown cellulose (R-Value = 38 h·ft ² ·°F/Btu) insulation in the ceiling and compared to the base REM/Design building.	
Cost	\$0.50/ft ² wall space being insulated 10 year and 5 year payback only	
<i>Ceiling Insulation</i>		
Definition of opportunity	Buildings with either a flat roof or a roof with an attic, no cathedral roofs. Ceilings with insulation at an R-value < R19 on a minimum of 25% of the ceiling area.	
Savings	The building is modeled using REM/Design with blown cellulose (R-Value = 38 h·ft ² ·°F/Btu) insulation in the ceiling and compared to the base REM/Design building.	
Cost	\$1.00/square foot ceiling space being insulated	
<i>Foundation Insulation</i>		
Definition of opportunity	Buildings with no foundation insulation and a full basement	
Savings	The building is modeled using REM/Design with insulation (R-Value = 11 h·ft ² ·°F/Btu) insulation on the interior wall of the basement and compared to the base REM/Design building.	
Cost	\$0.50/ft ² wall space being insulated	
<i>Rim Joist Insulation</i>		
Definition of	Buildings with no rim joist insulation.	

Measure	Estimate or Algorithm	Sources and Assumptions
opportunity		
Savings	The building is modeled using REM/Design with added batt fiberglass insulation (R-Value = 19 h·ft ² ·°F/Btu) insulation in the cavity space on the rim joist and compared to the base REM/Design building.	
Cost	\$0.60/ft ² rim joist space being insulated	
<i>Infiltration reduction (1&2 unit only) (sinf)</i>		
Definition of opportunity	$\frac{\text{ft}^3}{\text{min}} \times \frac{60 \text{ min}}{\text{h}} \times \frac{\text{ft}^3}{\text{h}} = \frac{\text{air}}{\text{h}}$ <p>Single family rental buildings that received a blower door test and have an infiltration rate of 10 ACH@ 50 Pa.</p>	
Savings	It is assumed that the reduced infiltration rate at 50 Pa is given by $Q_r = Q_{@50Pa} + (0.60 Q_{@50Pa} - 750 \text{ cfm})$. The building is modeled using REM/Design with the reduced infiltrations rate and compared to the base REM/Design building.	
Cost	\$100 + \$10/100 cfm reduced	
Heating Measures		
<i>Furnace Replacement</i>		
Definition of opportunity	Buildings w/ forced air furnace of 80 AFUE or less are replaced w/ 92 AFUE furnace	
Savings	The building is modeled using REM/Design with a sealed combustion furnace with 92 AFUE and compared to the base REM/Design building.	
Cost	\$2000	Current Focus on Energy multifamily program experience
<i>Furnace Replace on fail</i>		
Definition of	Buildings with forced air furnaces with an efficiency less than or	

Measure	Estimate or Algorithm	Sources and Assumptions
opportunity	equal to 80 AFUE that are at least 15 years old.	
Savings	The building is modeled using REM/Design with a sealed combustion furnace with 92 AFUE and compared to the base REM/Design building.	
Cost	\$500 per furnace installed. Cost represents the incremental cost between a standard furnace and a high efficiency furnace.	Current Focus on Energy multifamily program experience
<i>Electric to gas conversion</i>		
Definition of opportunity	Buildings with electric baseboard heat and a basement to install	
Savings	The building is modeled using REM/Design with a sealed combustion furnace with 92 AFUE and compared to the base REM/Design building.	
Cost	\$2000 furnace and \$2000 duct per system.	Current Focus on Energy multifamily program experience
<i>Boiler Replacement</i>		
Definition of opportunity	All boilers with 80 AFUE or less replaced with 92 AFUE boiler	
Savings	Modeled using REM Design	
Cost	\$4000 / 80 kBtu/h \$6000 / 250 kBtu/h \$11000 / 400 kBtu/h	
<i>Boiler Controls</i>		
Definition of opportunity	Boilers without OA reset or cutout controls.	
Savings	7.5% savings of modeled heating consumptions for systems w/o continuous circulation; 15% savings for systems w/ continuous	

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>
	circulation.	
Cost	\$375 per boiler.	
<i>Boiler replace on fail</i>		
Definition of opportunity	Boilers with efficiency of 80 AFUE or less that are at least 15 years old.	
Savings	The building is modeled using REM/Design with a 92 AFUE boiler and compared to the base REM/Design buildings.	
Cost	\$2500 / 80 kBtu/h \$3000 / 250 kBtu/h \$3500 / 400 kBtu/h Cost represents the incremental cost between a standard unit and a high efficiency unit.	
<i>Insulate HW Pipes</i>		
Definition of opportunity	The auditor observed either 5% coverage of insulation or no insulation to be considered qualified for the insulate DHW pipes. In a direct installation type program, an implementation contractor would install three feet of pipe insulation on the cold pipe and nine feet of insulation on the hot water pipe.	
Savings	The energy savings for this measure are default savings approved for use in the Focus on Energy program. The energy savings is 138 kWh for an electric water heater and seven therms for a natural gas water heater (assuming 12 feet of insulation are installed).	
Cost	Based on direct installation program experience, the installed cost of this measure is \$0.50 per linear foot.	
Domestic Hot Water Measures		
<i>Electric to Gas Conversion</i>		
Definition of opportunity	It is assumed that the gas company will bring a gas line into a common multifamily building location at no cost to the owner. The cost of running gas line throughout the building in an existing building to replace individual electric water heaters is too prohibitive. Therefore, multifamily buildings (3+ units) with	

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>
	individual electric water heaters are excluded.	
Savings	The water heater is replaced with a commercial sized water heater with a 92%EFF rating using natural gas or for residential size water heaters a 0.61EF water heater.	
Cost	\$600 for small water heaters (40 or 50 Gal), \$4500 for commercial water heaters (80 or 120 Gal)	
<i>Temperature Reduction</i>		
Definition of opportunity	For individual water heaters, the recorded temperature measured must be at 130 degrees or higher before it is considered a candidate for reduction to 125 degrees. For central water heaters, the <u>minimum</u> measured water temperature must be above 125F.	
Savings	For individual electric water heaters, the energy savings is 18 kWh per degree of turn down to 125 degrees. For natural gas water heaters, the energy savings is one therm per degree of turn down to 125 degrees. Savings for central water heaters are based on number of degrees of turn-down to 125 for the lowest measured temperature. For central water heaters, savings per water heater are adjusted upward based on tank volume. The adjustment is 1.0 for 70 gallons or less, 1.5 for 70-120 gallons, and 3.0 for more than 120 gallons. Adjustments are based on surface/volume ratios for a selection of water heaters.	Residential characterization study for savings for individual water heaters.
Cost	There is no cost to setting back the temperature of the domestic hot water heater.	
<i>Replace water heater, Sm. 0.61 or greater EF</i>		
Definition of opportunity	Building with water heaters less than 75 gallons and an EF<0.61 are modeled with new water heaters with EF=0.61	
Savings	Buildings are modeled with REM/Design and compared to a modeled building with a new water heater with EF=0.61	
Cost	\$600 per water heater installed	ACES
<i>Replace water heater, Lg. 90% or greater</i>		
Definition of opportunity	Buildings with water heaters greater than or equal to 75 gallons and an EF<0.61 are modeled with new water heaters with EF=0.61	

Measure	Estimate or Algorithm	Sources and Assumptions
Savings	Buildings are modeled with REM/Design and compared to a modeled building with a new water heater with EF=0.61	
Cost	\$4500 per water heater installed	ACES
<i>Insulate pipes</i>		
Definition of opportunity	Opportunity exists if the auditor observed pipe insulation on 5 percent or less of exposed hot water piping. In a direct installation type program, an implementation contractor would install three feet of pipe insulation on the cold pipe and nine feet of insulation on the hot water pipe.	
Savings	The energy savings for this measure are default savings approved for use in the Focus on Energy program. The energy savings is 138 kWh for an electric water heater and seven (7) therms for a natural gas water heater (assuming 12 feet of insulation are installed).	
Cost	Based on direct installation program experience, the installed cost of this measure is \$0.50 per linear foot.	
<i>Water heater wrap</i>		
Definition of opportunity	The domestic hot water heater must not have a tank wrap installed and the water heater must be more than 10 years old to qualify for this opportunity.	
Savings	The energy savings for this measure are default savings approved for use in the Focus on Energy program. The energy savings is 264 kWh for an electric water heater and 23 therms for a natural gas water heater.	
Cost	\$25 per tank wrap.	Focus on Energy multifamily program experience
<i>Low-flow showerhead</i>		
Definition of opportunity	The entire building was considered an opportunity for replacement if there was a flow rate of 2.5 gallons per minute (gpm) or more for 25 percent or more of tested showerheads. A direct install program would then replace all showerheads with a 2.0 gpm or 1.75 gpm model.	
Savings	200 kWh per year per showerhead for electric water heat; 10 therms per year per showerhead for gas water heat.	http://www.bpa.gov/Energy/N/reports/evaluation/residential_retrofit/

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>												
		faucet_aerator.cfm												
Cost	\$10 per showerhead.	Focus on Energy multifamily program experience												
ENERGY STAR Appliances Measures														
<i>Refrigerator replacement</i>														
Definition of opportunity	Any refrigerator potentially qualifies													
Savings	<p>Savings derived from metered sample of study refrigerators, and weighted to reflect statewide population.</p> <p>Savings = Existing refrigerator usage – replacement refrigerator usage</p> <p>Existing refrigerator usage based on metering data using methods described in Appendix E.</p> <p>Replacement refrigerator usage average of current Energy Star labeled top-freezer models by size category:</p> <table border="1" style="margin-left: 40px;"> <thead> <tr> <th>Size (ft³)</th> <th>kWh/yr</th> </tr> </thead> <tbody> <tr> <td><10</td> <td>285</td> </tr> <tr> <td>10 – 14.9</td> <td>341</td> </tr> <tr> <td>15 – 17.9</td> <td>394</td> </tr> <tr> <td>18 – 19.9</td> <td>409</td> </tr> <tr> <td>20 +</td> <td>432</td> </tr> </tbody> </table>	Size (ft ³)	kWh/yr	<10	285	10 – 14.9	341	15 – 17.9	394	18 – 19.9	409	20 +	432	
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<10	250													
10 – 14.9	425													
15 – 17.9	450													
18 – 19.9	500													
20 +	550													
<i>Washer replacement</i>														
Definition of opportunity	If the clothes washer was not an ENERGY STAR qualified model number, then it was considered qualified for replacement.													
Savings	The energy savings for this measure are default savings approved for use in the Focus on Energy program. There are four possible													

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>
	<p>combinations of water heat energy type and dryer energy type: electric water heat and electric dryer (936 kWh and 0 therms of energy savings), electric water heat and natural gas dryer (623 kWh and 10.7 therms), natural gas water heat and electric dryer (313 kWh and 24 therms), and natural gas water heat and natural gas dryer (0 kWh and 34.7 therms).</p> <p>The above figures are based on 400 loads of laundry per year. These were scaled for multifamily usage based on the average loads per year as reported in the tenant survey: single family rentals (269 loads/yr), 2 to 4 unit rentals (279 loads/yr for in-unit laundry, 247 loads/yr for common area laundry), 5 to 19 unit rentals (263 loads/yr for in-unit laundry, 127 loads/yr for common area laundry), and 20+ unit rentals (183 loads/yr for in-unit laundry, 135 loads/yr for common area laundry).</p>	
Cost	The average incremental cost difference between an ENERGY STAR model and a regular top loader is \$312.50.	Telephone calls to several appliance dealers
Lighting Measures		
<i>Exit Lights</i>		
Definition of opportunity	Any exit fixture qualifies if is not already LED (incandescent or fluorescent).	
Savings	For fixtures that are currently incandescent the equation is: $(24 \text{ hour/day}) \times (365 \text{ days/yr}) \times (40-2) \text{ watts} \times (1 \text{ kw}/1000 \text{ w}) = 333 \text{ kWh/fixture}$; and for fluorescent fixtures the equation is: $(24 \text{ hour/day}) \times (365 \text{ days/yr}) \times (12-2) \text{ watts} \times (1 \text{ kw}/1000 \text{ w}) = 87.6 \text{ kWh/fixture}$	
Cost	The cost assumption is \$40 per fixture.	
<i>CFLs in common areas</i>		
Definition of opportunity	Any fixture that is either incandescent or halogen qualify for this measure.	
Savings	The following are replacement assumptions: 40w replaced with 9w, 60w replaced with 15w, 75w replaced with 20w, and a 100w replaced with 25w. REM/design uses 8 hours of operation per day during heating season and 7 hours per day in cooling season.	
Cost	The cost assumption is \$60 per fixture installed.	

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>																																																				
<i>CFLS in apartments</i>																																																						
Definition of opportunity	In-unit incandescent bulbs (>20 watts) or halogen torchiere qualify for this measure																																																					
Savings	<p>Based on wattage reduction times hours used per day.</p> <p>Assumed wattage reduction: 2/3 of existing bulb wattage</p> <p>Hours of use assumed, according following algorithm:</p> <p>(1) Sort fixtures randomly by apartment and room within apartment, except all fluorescent fixtures ahead of all incandescents. Assign fixture sort order #.</p> <p>(2) Assume daily hours of operation by room and fixture sort # as follows:</p> <table border="1" data-bbox="454 934 1015 1354"> <thead> <tr> <th></th> <th>1st</th> <th>2nd</th> <th>Others</th> </tr> </thead> <tbody> <tr><td>Bathroom</td><td>4</td><td>2</td><td>1</td></tr> <tr><td>Bedroom</td><td>2</td><td>1</td><td>0.5</td></tr> <tr><td>Basement</td><td>0.5</td><td>0.25</td><td>0.1</td></tr> <tr><td>Closet</td><td>0.5</td><td>0.25</td><td>0.1</td></tr> <tr><td>Dining room</td><td>4</td><td>2</td><td>1</td></tr> <tr><td>Entryway</td><td>2</td><td>1</td><td>0.5</td></tr> <tr><td>Garage</td><td>0.5</td><td>0.25</td><td>0.1</td></tr> <tr><td>Hall</td><td>2</td><td>1</td><td>0.5</td></tr> <tr><td>Kitchen</td><td>4</td><td>2</td><td>1</td></tr> <tr><td>Living room</td><td>4</td><td>4</td><td>1</td></tr> <tr><td>Outdoor</td><td>7</td><td>3</td><td>1</td></tr> <tr><td>Rec room</td><td>4</td><td>4</td><td>1</td></tr> </tbody> </table>		1st	2nd	Others	Bathroom	4	2	1	Bedroom	2	1	0.5	Basement	0.5	0.25	0.1	Closet	0.5	0.25	0.1	Dining room	4	2	1	Entryway	2	1	0.5	Garage	0.5	0.25	0.1	Hall	2	1	0.5	Kitchen	4	2	1	Living room	4	4	1	Outdoor	7	3	1	Rec room	4	4	1	
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Living room	4	4	1																																																			
Outdoor	7	3	1																																																			
Rec room	4	4	1																																																			
Cost	<p>\$3 for CFL replacements for incan. from 20-75 watts</p> <p>\$7 for CFL replacements for incan. from 76-150 watts</p> <p>\$15 for CFL replacements for incan. >150 watts</p> <p>\$15 for CFL replacements for 3-way bulbs or fixtures on dimmers</p> <p>\$75 for CFL replacement for halogen torchiere lamp</p>																																																					
<i>Lighting controls (occupancy sensor)</i>																																																						
Definition of	This measure is for outdoor lighting only (plus the entry fixture in a building). The fixture qualifies for an opportunity if it is on																																																					

<u>Measure</u>	<u>Estimate or Algorithm</u>	<u>Sources and Assumptions</u>
opportunity	24/7 or controlled only by a switch.	
Savings	If the fixture is operated 24/7, the opportunity is to reduce the operating hours by 12 per day. If the fixture is controlled by a switch, the savings is calculated by reducing the hours by two (2) per day.	
Cost	The cost assumption is \$100 per fixture.	

APPENDIX E: ANALYSIS OF REFRIGERATOR MONITORING DATA

Refrigerator monitoring data analysis

Refrigerator (and occasionally stand-alone freezer) electricity consumption was monitored during the on-site data collection for the sampled buildings. Monitoring was attempted for all refrigerators in sampled apartments, and was also collected for some units in common areas. The data collection protocol called for collecting data for a minimum of two hours, though in some cases this could not be achieved.

We used Brultech ECM1200 meters to record electricity consumption by the units. The meters recorded average power draw over one-minute intervals. We obtained data for a total of 402 units. Due to problems linking the monitoring data with the other on-site data, monitoring data for 26 units could not be tied to a specific refrigerator in the other on-site data. In addition, only a small number of stand-alone freezers (11) were monitored. We did not include these in subsequent analyses.

Figure 2 shows the regular pattern of on/off cycles that is typical of the monitored refrigerators. To analyze the data, we generally discarded the partial cycles at the beginning and end of the monitoring period, and estimated annual electricity use based on complete cycles. We also discarded automatic defrost cycles and the ‘off’ and ‘on’ cycle immediately following a defrost cycle (as is discussed in more detail later in this appendix). This approach was successful for 264 of the monitored refrigerators.

Some refrigerators ran for the entire monitoring period, however, and some ran for such long periods that we could not obtain even one complete ‘off’ and ‘on’ cycle within the monitoring period. Moreover, some did not run at all during monitoring. With the exception of the units that did not run at all, we based the analysis for these units on the entire period of monitoring (after discarding periods related to defrost cycles), provided we had at least 90 minutes of recovered data. We discarded data that showed no run time at all during the monitoring period on the grounds that these were likely errors in correctly connecting the metering. This secondary approach yielded an additional 55 refrigerators for the analysis, for a total of 319 units.

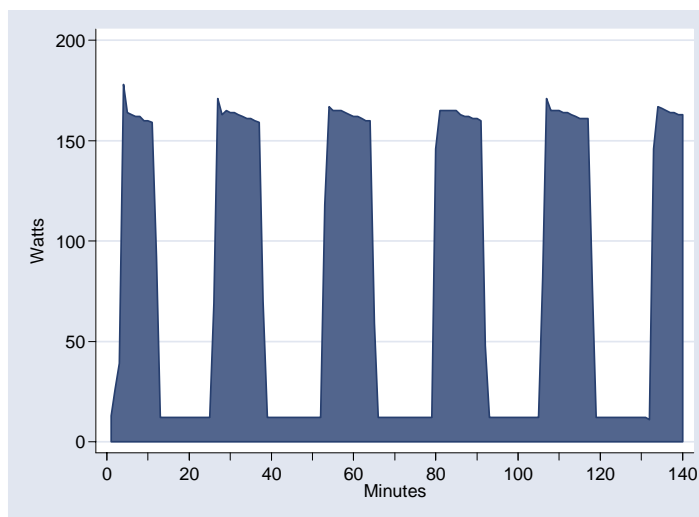
We reduced the one-minute metering data to the following summary values for each monitored unit:

C_{on} = number of observed “on” cycles

C_{off} = number of observed “off” cycles

M_{on} = total minutes of observed “on” time

Figure 2. Monitoring data for a typical refrigerator.



M_{off} = total minutes of observed “off” time

W_{on} = average wattage draw during “on” cycle

W_{off} = average wattage draw during “off” cycle

From the above quantities, we calculated the duty cycle of each unit as:

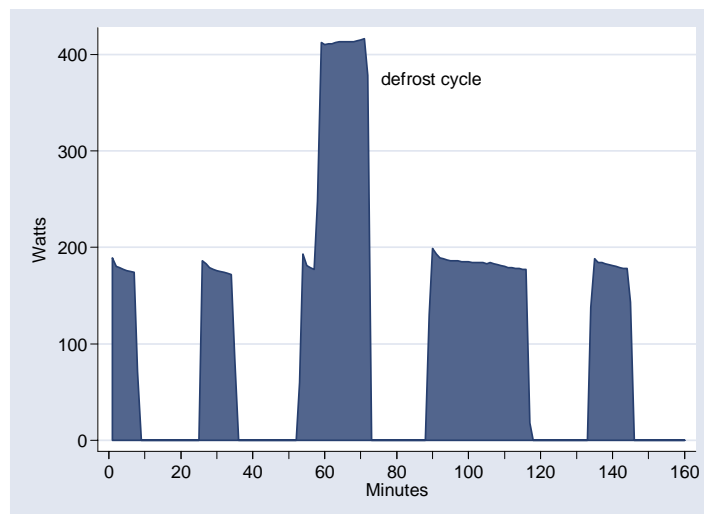
$$F_{\text{on}} = (M_{\text{on}})/(M_{\text{on}}+M_{\text{off}})$$

And we calculated an estimate of annual electricity use (excluding defrost cycle for auto-defrost units) as:

$$\text{Annual kWh (excluding defrost)} = 8760 * (F_{\text{on}} * W_{\text{on}} + (1-F_{\text{on}}) * W_{\text{off}}) / 1000$$

Figure 3. Typical refrigerator defrost cycle.

The monitoring data comprised 44 units that underwent an automatic defrost cycle during monitoring. Figure 3 shows a typical defrost cycle. Analysis of these units indicated that the average defrost cycle draws about 400 additional Watts of power and lasts about 12 minutes. We also found that the on-cycle following a defrost cycle averaged about 20 minutes longer than a typical on-cycle for the same refrigerator. Using these values, we estimated the annual defrost energy for all automatic-defrost units as follows:



$$\text{Annual kWh for defrost} = (8760 * F_{\text{on}} / 12) * (0.4 * 12 / 60 + W_{\text{on}} / 1000 * 20 / 60)$$

Where

F_{on} = the measured fraction of the time the compressor runs

W_{on} = average running wattage of the unit

The above equation uses a rule of thumb of 12 compressor run-time hours between each defrost cycle.⁵ We then added the estimated defrost and non-defrost electricity to get an estimate of total electricity use for each unit. On average, this increased the estimate of annual electricity use by about seven percent for

⁵ Personal communication with Jim Mapp, Wisconsin Department of Administration, April 21, 2004.

units with this feature. Automatic or manual defrost was recorded for only about half of the units in the data set. We imputed the type of defrost for the remaining units based on the following rules:

- Automatic defrost if unit is 10 years old or less
- Randomly classified as automatic defrost with probability of 85% if more than 10 years old
- Randomly classified as automatic defrost with probability of 60% if age is unknown

This procedure classified 86 percent of units (unweighted) with unknown defrost type as automatic defrost, as compared to 88 percent of units where the defrost type was recorded in the field.

Finally, the data were weighted to reflect the total number of rental refrigerators in the state, based on an assumption of one refrigerator per housing unit, and common-area refrigerators in proportion to those we encountered in our sample. The weights totaled to an estimated 662,460 rental-sector refrigerators in Wisconsin.

APPENDIX F: DATA COLLECTION INSTRUMENTS



Wisconsin Rental Housing Energy Use Study Owner/Manager Survey

The questions that follow pertain to the rental building at

(to be completed by field staff)

ABOUT THE BUILDING

S1. When was this building built? **[S1]**

(Circle the number of your answer below.)

- 1 1990 or later
- 2 1980-1989
- 3 1970-1979
- 4 1960-1969
- 5 1950-1959
- 6 1940-1949
- 7 1930-1939
- 8 Prior to 1930

S2. Is this building part of a complex of buildings at this location, or is it the only building at this location? **[S2]**

(Circle the number of your answer below.)

- 1 The only building at this location ▶ ▶ ▶ ▶ Skip to Question S3
- 2 Part of a complex of buildings →

[S2a]

How many separate buildings with apartments are at this location?

(Write in your answer below.)

_____ Separate buildings

How many total rental units are at this complex? **[S2b]**

(Write in your answer below.)

_____ Total units

Is this building typical of buildings in this complex? [S2c]

(Circle the number of your answer below.)

1 No → **How does it differ?**

_____ **[S2c1]**

2 Yes

S3. Was this building originally built as a multi-unit apartment building, was it converted from a single family home, or something else? [S3]

(Circle the number of your answer below.)

1 Built as a multi-family apartment building

2 Converted from single family home

3 Something else → **Please describe:** _____

_____ **[S3a]**

S4. How many on-site staff are there for this building/complex?

(Write in your answer below.)

_____ Number of on-site staff **[S4]**

ABOUT THE APARTMENTS

A1. What is the *lowest* monthly rent in this building?

(Write in your answer below.)

\$ _____ Lowest monthly rent **[A1a]**

What is the approximate square footage of the unit with the lowest rent?

(Write in your answer below.)

_____ Square feet **[A1b]**

A2. What is the *highest* monthly rent in this building?

(Write in your answer below.)

\$ _____ Highest monthly rent **[A2a]**

What is the approximate square footage of the unit with the highest rent?*(Write in your answer below.)*_____ Square feet **[A2b]****A3. Are rents for units in this building regulated? [A3]***(Circle one number)*

- 1 No
2 Yes →

What are the regulations?

[A3a]**A4. How many of each type of unit are in this building?***(Write in your answers below. If there are none of a type put in 0)*

- _____ Single-room units with no bathroom **[A4a]**
 _____ Efficiency or Studio units **[A4b]**
 _____ 1 bedroom **[A4c]**
 _____ 2 bedrooms **[A4d]**
 _____ 3 or more bedrooms **[A4e]**
 _____ **Total units in building [A4f]**

A5. What percent of the units in this building are occupied by...?*(Write in your answers below. If there are none of a type put in 0. Percents below need not total 100)*

- ...Students _____ percent **[A5a]**
 ...Low-income tenants _____ percent **[A5b]**
 ...Elderly tenants _____ percent **[A5c]**

OWNERSHIP AND MANAGEMENT

O1. For this particular property, are you . . . ? [O1]*(Circle the number of your answer below.)*

- 1 ...an owner of the property
2 ...a resident manager or superintendent

- 3 ...a non-resident manager or someone employed by a management company responsible for managing the property
- 4 ...somebody else (Please specify: _____) [O1a]

O2. How would you describe the ownership of this particular building? [O2]
(Circle the number of your answer below.)

- 1 Individual investors (e.g., husband/wife)
- 2 Partnership (limited or general)
- 3 Real estate investment trust
- 4 Real estate or other corporation
- 5 Non-profit/church-related institution
- 6 Financial institution
- 7 Trustee for estate
- 8 Government owned
- 9 Other (Please specify: _____) [O2a]

O3. How many years have you (or has your firm) been in business owning and or managing multi-family housing properties?
(Write in your answer below.)

_____Years [O3]

O4. How long have you (or has your firm) owned or managed this building? [O4]
(Circle the number of your answer below.)

- 1 Less than 1 year
- 2 1 to 2 years
- 3 3 to 4 years
- 4 5 to 10 years
- 5 More than 10 years

O5. Who handles each of the following activities for this building?
(Circle the number of your answer(s) for ALL that apply below.)

	Owner(s)	Resident Manager	Non-resident employees of management company	Contractors hired for tasks	Other - describe
Renting of apartments [O5a]	1	2	3	4	5 _____ [O5a1]

Routine maintenance [O5b]	1	2	3	4	5	[O5b1]
Calls from tenants [O5c]	1	2	3	4	5	[O5c1]
Small plumbing repairs [O5d]	1	2	3	4	5	[O5d1]
Small electrical repairs [O5e]	1	2	3	4	5	[O5e1]

O6. Considering just Wisconsin, about how many properties and dwelling units do you (or does your firm)...
(Write in your answers below.)

	Properties	Dwelling Units
Own and manage	_____ [O6a1]	_____ [O6a2]
Manage only	_____ [O6b1]	_____ [O6b2]
Own but not manage	_____ [O6c1]	_____ [O6c2]

O7. Does this building or complex have clothes washers and dryers in a common area? [O7]
(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question R1
- 2 Yes → **Do tenants pay to use the washers or dryers? [O7a]**
 - 1 No ▶▶▶▶ Skip to Question R1
 - 2 Yes

O8. Which of the following describes your arrangement with respect to the laundry equipment? [O8]
(Circle the number of your answer below.)

- 1 You own or lease the equipment and collect all the revenue
- 2 You share the revenue with the company that provides the laundry equipment
- 3 You charge a monthly fee to the company that owns the laundry equipment

- 4 You provide space for no charge to the company that owns the laundry equipment
- 5 Something else (Please describe: _____) **[O8a]**

RENTING CHARACTERISTICS

R1. How familiar are you with what tenants look for when renting an apartment? **[R1]**

(Circle the number of your answer below.)

- 1 Not at all familiar ▶ ▶ ▶ ▶ Skip to Question T1
- 2 Somewhat familiar
- 3 Very familiar

R2. How important do you think each of the following characteristics are to potential tenants?

(Circle one number for each characteristic below.)

	Not at all Important						Very Important
Location	1	2	3	4	5	6	[R2a]
Size of apartment	1	2	3	4	5	6	[R2b]
Number of bedrooms	1	2	3	4	5	6	[R2c]
Monthly rent	1	2	3	4	5	6	[R2d]
Energy costs	1	2	3	4	5	6	[R2e]
Amenities	1	2	3	4	5	6	[R2f]
Size of the building/complex	1	2	3	4	5	6	[R2g]
Proximity to mass transit	1	2	3	4	5	6	[R2h]
Availability of parking	1	2	3	4	5	6	[R2i]

R3. When prospective tenants are looking to rent in this building, what percent of them ask about energy costs? **[R3]**

(Circle the number of your answer below.)

- 1 None
- 2 Less than 25 percent
- 3 Between 26 and 50 percent
- 4 Between 51 and 75 percent
- 5 More than 75 percent

TENANT UTILITY BILL CHARACTERISTICS

T1. Which of the following best describes how the costs for heating the individual apartment units are paid for this building? [T1]

(Circle the number of your answer below.)

- 1 Included in the rent
- 2 Paid by the tenants directly to the fuel provider
- 3 Other (please describe: _____) [T1a]

T2. Do tenants in this building pay an electric bill directly to the electric utility? [T2]

(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question T3
- 2 Yes →

What is included in the *tenant's* electric bill?

(Circle the number for all that apply below.)

- 1 range/oven [T2a]
- 2 water heating [T2b]
- 3 space heating [T2c]
- 4 wall/window air conditioning [T2d]
- 5 refrigerator [T2e]
- 6 lighting and plug-in appliances [T2f]
- 7 clothes dryer [T2g]
- 8 other appliances (please describe _____) [T2h], [T2h1]

T3. Do tenants in this building pay a natural gas bill directly to the natural gas utility? [T3]

(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question T4
- 2 Yes →

What is included in the *tenant's* gas bill?

(Circle all that apply)

- 1 range/oven [T3a]

- 2 water heating **[T3b]**
- 3 space heating **[T3c]**
- 4 clothes dryer **[T3d]**
- 5 other appliances (please describe _____) **[T3e], [T3e1]**

T4. Do tenants in this building pay either a propane or fuel oil bill directly to a provider? **[T3a]**

(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question W1
- 2 Yes →

What is included in the tenant’s propane or fuel oil bill?

(Circle all that apply)

	Propane	Fuel Oil	Neither	
Space Heating	1	2	3	[T4a]
Water Heating	1	2	3	[T4b]
Range or Oven	1	2	3	[T4c]
Clothes Dryer	1	2	3	[T4d]
Other (specify: _____) [T4e1]	1	2	3	[T4e]

APARTMENT APPLIANCES

W1. Who provides the appliances below for typical rental units in this building?

(Circle the number of your answer for each item below.)

	Included with rental unit	Provided by tenant	Not typically present in rental unit	
Refrigerator	1	2	3	[W1a]
Range/Oven	1	2	3	[W1b]
Dishwasher	1	2	3	[W1c]
Microwave	1	2	3	[W1d]
In-unit clothes washer and dryer	1	2	3	[W1e]

Window or wall air conditioner	1	2	3	[W1f]
Stand-alone freezer	1	2	3	[W1g]

▶ ▶ ▶ ▶ If you circled “2” or “3” to all of these items, skip to **Question C1.**

W2. Have you installed or purchased any of the following major appliances for this building in the past two years?

(Circle the number of your answer below; write in your answers for any appliances that have been installed in the last two years.)

		Replaced in last two years?			If Yes, how many...	
		No	Yes	→	...replaced existing units?	...were additions that did not replace existing units?
Refrigerator	[W2a]	1	2	→	_____# [W2a1]	_____# [W2a2]
Stand-alone freezer	[W2b]	1	2	→	_____# [W2b1]	_____# [W2b2]
Room air conditioner	[W2c]	1	2	→	_____# [W2c1]	_____# [W2c2]
Dishwashers	[W2d]	1	2	→	_____# [W2d1]	_____# [W2d2]
Clothes washers	[W2e]	1	2	→	_____# [W2e1]	_____# [W2e2]
Clothes dryers	[W2f]	1	2	→	_____# [W2f1]	_____# [W2f2]

W3. How likely is it that you will purchase or replace any of these appliances in the next year for this building?

(Circle the number of your answer for each item below.)

	Very Unlikely	Somewhat Unlikely	Somewhat Likely	Very Likely
Room Air Conditioner	1	2	3	4
[W3a]				
Refrigerator	1	2	3	4
[W3b]				
Stand-alone Freezer	1	2	3	4
[W3c]				
Dishwasher(s)	1	2	3	4
[W3d]				
Clothes washer(s)	1	2	3	4
[W3e]				

Clothes dryer(s)	1	2	3	4
[W3f]				

W4. When you purchase major appliances for this building, are you more likely to buy them...? [W4]

(Circle the number of your answer below.)

- 1 ...from models available through pre-negotiated contract
- 2 ...through a bidding process
- 3 ...making an on the spot selection from models that are available
- 4 ...other (please specify: _____) **[W4a]**

W5. Which of the following best describes where you purchase major appliances for the apartments in this building? [W5]

(Circle the number of your answer below.)

- 1 Local or regional appliance dealer
- 2 National chain (such as Best Buy, Sears, or other department store)
- 3 Local distributor or wholesaler
- 4 Manufacturer's distributor or manufacturer such as GE or Whirlpool
- 5 Other (please specify _____) **[W5a]**

W6. When you purchase major appliances for the apartments in this building, are they more likely to be new or used? [W6]

(Circle the number of your answer below.)

- 1 Always new
- 2 Mostly new
- 3 Sometimes new and sometimes used
- 4 Mostly used
- 5 Always used

W7. When you are purchasing major appliances for the apartments, how important are each of the following in your decision regarding what to purchase?

(Circle the number of your answer for each item below.)

	Not at all Important				Very Important
Replacing with an identical or nearly identical model	1	2	3	4	[W7a]
Expected life of the appliance	1	2	3	4	[W7b]
Price	1	2	3	4	[W7c]
Past experience with the brand	1	2	3	4	[W7d]
Reliability	1	2	3	4	[W7e]
Ease of maintenance	1	2	3	4	[W7f]
Energy use	1	2	3	4	[W7g]

BUILDING COMFORT

C1. Overall, how well would you say this building is insulated? [C1]*(Circle the number of your answer below.)*

- 1 No insulation
- 2 Poorly insulated
- 3 Adequately insulated
- 4 Well insulated
- 5 Don't know

C2. How would you describe the general level of comfort in this building in the winter? [C2]*(Circle the number of your answer below.)*

- 1 Very uncomfortable
- 2 Somewhat uncomfortable
- 3 Somewhat comfortable
- 4 Very comfortable
- 5 Don't know

C3. How would you describe the general level of comfort in this building in the summer? [C3]*(Circle the number of your answer below.)*

- 1 Very uncomfortable
- 2 Somewhat uncomfortable
- 3 Somewhat comfortable
- 4 Very comfortable
- 5 Don't know

C4. In the past year, how frequently have tenants contacted you regarding ...*(Circle the number of your answer for each item below.)*

	Never	Rarely	Occasionally	Frequently	
Living units too cold or drafty in the winter	1	2	3	4	[C4a]
Living units too hot in the winter	1	2	3	4	[C4b]
Living units too cold or drafty in the summer	1	2	3	4	[C4c]
Living units too hot in the summer	1	2	3	4	[C4d]
Problems with the hot water	1	2	3	4	[C4e]
Problems with odors from other units	1	2	3	4	[C4f]

Problems with lighting (other than burnt out bulbs)	1	2	3	4	[C4g]
Comfort problems in common areas	1	2	3	4	[C4h]
Other (describe: _____) [C4i1]	1	2	3	4	[C4i]

BUILDING CHANGES OR IMPROVEMENTS

B1. In the past five years have any of the following changes been made to this building?*(Circle the number of your answer for each item below.)*

	No	Yes	
Upgraded the heating system	1	2	[B1a]
Plumbing upgrades or changes	1	2	[B1b]
Added or upgraded air conditioning	1	2	[B1c]
Renovated kitchen(s)	1	2	[B1d]
Renovated bathroom(s)	1	2	[B1e]
Added a security system	1	2	[B1f]
Added playground equipment	1	2	[B1g]
Made the building more accessible to the handicapped	1	2	[B1h]

B2. Has this building received an energy audit from a utility representative or other energy professional in the past? (An energy audit would include recommendations regarding changes you could make to the building to save energy.) [B2]*(Circle the number of your answer below.)*

- 1 No
- 2 Yes
- 3 Don't know

B3. In your opinion, which of the following statements best describes the opportunities for energy savings in this building that could be taken by the owners or management company? [B3]*(Circle the number of your answer below.)*

- 1 There is little or nothing management could do to further reduce energy costs in this building
- 2 There are a few things management could do to further reduce energy costs in this building
- 3 There are many things management could do to further reduce energy costs in this building
- 4 Don't know

B4. In your opinion, which of the following statements best describes the opportunities for energy savings in this building that could be taken by tenants? [B4]

(Circle the number of your answer below.)

- 1 There is little or nothing tenants could do to further reduce energy costs in this building
- 2 There are a few things tenants could do to further reduce energy costs in this building
- 3 There are many things tenants could do to further reduce energy costs in this building
- 4 Don't know

B5. When you are making upgrades to this building or its equipment, what financial criterion is applied? [B5]

(Circle the number of your answer below.)

- 1 Payback period of _____ years or less [B5a]
- 2 Return on investment of _____ percent [B5a]
- 3 No specific financial criteria applied
- 4 Other (please describe: _____) [B5a]

B6. When equipment in this building is changed or replaced, who is most likely to have the largest say in determining what is purchased?

(Circle the number of your answer for each item below.)

Describe	Owner	Mgt. company	Maint. staff	Other →	
Replacing in-unit appliances _____ [B6a1]	1	2	3	4	[B6a]
Replacing hallway lighting _____ [B6b1]	1	2	3	4	[B6b]
Purchasing a new water heater _____ [B6c1]	1	2	3	4	[B6c]
Painting an apartment _____ [B6d1]	1	2	3	4	[B6d]
Roofing _____ [B6e1]	1	2	3	4	[B6e]
Replacing a furnace or boiler _____ [B6f1]	1	2	3	4	[B6f]
Replacing in unit bathroom or kitchen fixture _____ [B6g1]	1	2	3	4	[B6g]

Replacing a window/wall air conditioner 1 2 3 4 **[B6h]**
_____ **[B6h1]**

B7. Are there any plans for major modifications or remodeling to this building within the next two years? **[B7]**

(Circle the number of your answer below.)

- 1 No
- 2 Yes →

What changes are planned?

[B7a]

B8. How important is each of the following in the decision to make changes to this building?

(Circle the number of your answer for each item below.)

	Not at all Important	Somewhat important	important	Very Important	
Resale value of the building	1	2	3	4	[B8a]
Staying competitive in the rental market	1	2	3	4	[B8b]
Tenant comfort	1	2	3	4	[B8c]
Safety	1	2	3	4	[B8d]
Reducing utility costs	1	2	3	4	[B8e]
Ability to charge higher rent	1	2	3	4	[B8f]
Reduced maintenance costs	1	2	3	4	[B8g]
Vacancy rates in the area	1	2	3	4	[B8h]

B9. Have you ever installed energy-saving items or measures and then been dissatisfied with them? [B9]

(Circle the number of your answer below.)

- 1 No
- 2 Yes →

Which items? _____

_____ [B9a]

In what way(s) were you dissatisfied? _____

_____ [B9b]

MAINTENANCE AND REPAIRS

M1. How often is the heating equipment in this building cleaned and tuned? [M1]

(Circle the number of your answer below.)

- 1 More than once a year
- 2 Once a year
- 3 Every other year
- 4 Every 3-6 years
- 5 Hardly ever
- 6 Never
- 7 Don't know

M2. Does this building have one or more boilers for space heating? [M2]

(Circle the number of your answer below.)

- 1 No ▶ ▶ ▶ ▶ Skip to Question M7
- 2 Yes

M3. How often do you drain the boiler sediments? [M3]

(Circle the number of your answer below.)

- 1 More than once a year
- 2 Once a year
- 3 Every other year
- 4 Every 3-6 years
- 5 Hardly ever
- 6 Never
- 7 Don't know

M4. How often do you flush the boiler reservoir? [M4]

(Circle the number of your answer below.)

- 1 More than once a year
- 2 Once a year
- 3 Every other year
- 4 Every 3-6 years
- 5 Hardly ever
- 6 Never
- 7 Don't know

M5. How often do you add water treatment? [M5]

(Circle the number of your answer below.)

- 1 More than once a year
- 2 Once a year

- 3 Every other year
- 4 Every 3-6 years
- 5 Hardly ever
- 6 Never
- 7 Don't know

M6. How often do you lubricate the circulation pump(s)? [M6]

(Circle the number of your answer below.)

- 1 More than once a year
- 2 Once a year
- 3 Every other year
- 4 Every 3-6 years
- 5 Hardly ever
- 6 Never
- 7 Don't know

M7. How often is air conditioning equipment cleaned or serviced? [M7]

(Circle the number of your answer below.)

- 0 There is no air conditioning equipment in this building ▶ ▶ ▶ ▶ Skip to Question P1
- 1 More than once a year
- 2 Once a year
- 3 Every other year
- 4 Every 3-6 years
- 5 Hardly ever
- 6 Never
- 7 Don't know

M8. Which of the following best describes what is done with window or wall air conditioners in the winter? [M8]

(Circle the number of the answer that describes what you do with most of your units.)

- 0 Don't have window or wall air conditioner(s)
- 1 Tenants are responsible for the handling of window/wall air conditioner(s) in the winter
- 2 Cover the air conditioner and leave it in the window/wall
- 3 Take the air conditioner(s) out of the window
- 4 Other (please describe:

_____) [M8a]

M9. Has this building required any substantial repairs in the last two years? [M9]

(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question P1
- 2 Yes → Please describe what was done:

[M9a]

M10. Did any of the repairs above address water damage? [M10]

(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question M11
- 2 Yes →

What caused the water damage?

(Circle the number of your answer(s) for ALL that apply below.)

- 1 Roof leak [M10a]
- 2 Plumbing leak [M10b]
- 3 Ice dams [M10c]
- 4 Window leaks [M10d]
- 5 Condensation [M10e]
- 6 Other [M10f]

(please describe: _____) [M10f1]

M11. Were any of the repairs above address problems with mold? [M11]*(Circle the number of your answer below.)*

- 1 No ▶ ▶ ▶ ▶ Skip to Question P1
 2 Yes →

Where was the mold, and how did you deal with it?

[M11a]

OPERATING COSTS

P1. Below are 6 types of costs to operate an apartment building. Please indicate the three largest annual operating costs by putting the letter associated with the cost on the appropriate line below.*(Write in the letters of your answers below.)*

- A Taxes, all types
 B Mortgages/interest/insurance
 C Energy and other utility costs
 D Maintenance and repairs
 E Management fees
 F Other (please describe: _____) **[P1c1describe]**

_____ Highest annual operating cost **[P1a]**
 _____ Second highest annual operating cost **[P1b]**
 _____ Third highest annual operating cost **[P1c]**

P2. Approximately what percentage of the total operating cost for this building is spent on energy? [P2]*(Circle the number of your answer below.)*

- 1 Less than 1 percent
 2 Between 2 and 5 percent
 3 Between 6 and 10 percent
 4 Between 11 and 20 percent
 5 Between 21 and 30 percent
 6 More than 30 percent
 7 Don't know

P3. Compared to other operating costs, how important is it to decrease your energy costs? [P3]

(Circle the number of your answer below.)

Not at all Important					Very Important
1	2	3	4	5	

P4. How interested are you (is your company) in making aesthetic or other types of improvements to this rental building, other than for energy efficiency purposes? [P4]

(Circle the number of your answer below.)

Not at all Interested					Very Interested
1	2	3	4	5	

P5. How interested are you (or is your firm) in making energy efficiency improvements to this rental building? [P5]

(Circle the number of your answer below.)

Not at all Interested					Very Interested
1	2	3	4	5	

P6. Do you have specific plans to improve the energy efficiency or to reduce the energy costs to operate this facility in the next three years? [P6]

- 1 No
- 2 Yes →

What do you plan to do to reduce energy costs?

[P6a]

P7. May we contact you in the future if we have questions about this or other studies?

[P7]

- 1 No
- 2 Yes →

Your name: _____ **[P7a]**

Telephone number: _____ **[P7b]**

Thank you for taking the time to fill out this survey. Your information will help us a great deal in completing our research. Please mail this completed questionnaire in the postage-paid envelope to:

**Wisconsin Rental Housing Energy Use Study
c/o Franklin Energy Services
312 North Franklin Street
Port Washington, WI 53074**

(to be filled in by field crew)



Wisconsin Rental Housing Energy Use Study

Tenant Survey

PLEASE TAKE A FEW MINUTES TO COMPLETE THIS QUESTIONNAIRE AND RETURN IT IN THE POSTAGE-PAID RETURN ENVELOPE. AS OUR WAY OF SAYING "THANK YOU," WE WILL SEND YOU A CHECK FOR \$15 ONCE WE RECEIVE YOUR COMPLETED QUESTIONNAIRE AND SIGNED UTILITY RELEASE FORM.

WE ARE VERY INTERESTED IN WHAT YOU—AS A TENANT IN THIS BUILDING—HAVE TO TELL US. THE BACK PAGE OF THIS QUESTIONNAIRE HAS MORE INFORMATION ABOUT OUR STUDY.

YOUR APARTMENT

1. How long have you lived in this apartment unit? [Q1]

(Circle the number of your answer below.)

- 1 Less than 1 year
- 2 1 to 2 years
- 3 3 to 4 years
- 4 5 to 10 years
- 5 More than 10 years

2. Which of the following best describes your apartment unit? [Q2]

(Circle the number of your answer below.)

- 1 Single room with no bathroom
- 2 Efficiency or studio
- 3 One bedroom
- 4 Two bedrooms
- 5 Three bedrooms
- 6 Four or more bedrooms

3. Does your individual apartment unit have its own basement? [Q3]

(Circle the number of your answer below.)

- 1 No ▶▶▶▶ Skip to Question 4
- 2 Yes →

Do you use any of the basement as a regular part of your living space? [Q3a]

(Circle the number of your answer below.)

- 1 No
- 2 Yes

4. How important were each of the following factors in deciding to rent at this location?

(Circle the number of your answer for each item below.)

	Not at all Important					Very Important
	1	2	3	4	5	6
Location	1	2	3	4	5	6 [Q4a]
Size of apartment	1	2	3	4	5	6 [Q4b]
Number of bedrooms	1	2	3	4	5	6 [Q4c]
Monthly rent	1	2	3	4	5	6 [Q4d]
Energy costs	1	2	3	4	5	6 [Q4e]
Amenities	1	2	3	4	5	6 [Q4f]
Size of the building/complex	1	2	3	4	5	6 [Q4g]
Proximity to mass transit	1	2	3	4	5	6 [Q4h]
Availability of parking	1	2	3	4	5	6 [Q4i]

5. Overall, how well is your apartment building insulated? [Q5]

(Circle the number of your answer below.)

- 1 No insulation
- 2 Poorly insulated
- 3 Adequately insulated
- 4 Well insulated
- 5 Don't know

APPLIANCES

6. Who provided the following appliances for your apartment unit?

(Circle the number of your answer for each item below.)

	Your landlord	You	Don't have	
Refrigerator	1	2	3	[Q6a]
Stand-Alone Freezer	1	2	3	[Q6b]
Range/Oven	1	2	3	[Q6c]

7. Which of the following best describes where your household does clothes washing?

[Q7]

(Circle the number of your answer below.)

- 1 In your apartment unit
- 2 In your building, but not in your apartment unit

- 3 In a different building in your apartment complex ▶ ▶ ▶ ▶ Skip to Question 11
- 4 At a laundromat or somewhere else outside the apartment building or complex ▶ ▶ ▶ ▶ Skip to Question 11

8. Who provided the clothes washer and dryer that you use?

(Circle the number of your response for each item below.)

	Your landlord	You	Don't have	
Clothes Washer	1	2	3	[Q8a]
Clothes Dryer	1	2	3	[Q8b]

9. About how many loads of laundry do you wash per week? _____ [Q9]

(Write in your answer above.)

What percent of these are...

(Write in your answers below)

- ...hot water washes? _____ percent [Q9a]
- ...warm water washes? _____ percent [Q9b]
- ...cold water washes? _____ percent [Q9c]

10. About how many loads of laundry do you dry per week in a clothes dryer? _____

[Q10]

(Write in your answer above.)

11. Do you have an automatic dishwasher in your apartment unit? [Q11]

(Circle the number of your answer below.)

- 1 No ▶ ▶ ▶ ▶ ▶ Skip to Question 12
- 2 Yes →

About how many times a week do you run it? _____ [Q11a]

(Write in the number of your answer above.)

Is it a built-in dishwasher or a portable dishwasher that you hook up to a faucet? [Q11b]

(Circle the number of your answer below.)

- 1 Built in ▶ ▶ ▶ ▶ ▶ Skip to Question 12
- 2 Portable →

Who provided the dishwasher? [Q11c]

(Circle the number of your answer below.)

- 1 You
- 2 Your landlord

12. About how many showers and baths are taken in your home in a typical week?

_____ [Q12]

(write in your answer above.)

13. How many of the following items are used in your home?*(circle the appropriate number for each appliance. If you have more than three, circle three.)*

	None	One	Two	Three or more	
Color television	0	1	2	3	[Q13a]
Black & white television	0	1	2	3	[Q13b]
VCR or DVD player	0	1	2	3	[Q13c]
Stereo system	0	1	2	3	[Q13d]
Humidifier	0	1	2	3	[Q13e]
Air filter/cleaner	0	1	2	3	[Q13f]
Heated waterbed	0	1	2	3	[Q13g]
Heated aquarium (20 gallons or more)	0	1	2	3	[Q13h]

14. Do you have a dehumidifier? [Q14]*(Circle the number of your answer below.)*

1 No ▶▶▶▶▶ Skip to Question 15

2 Yes →

How much is it used? [Q14a]*(Circle the number of your answer below.)*

1 It is rarely used

2 It is used for a part of the summer

3 It is used all summer long

Who provided the dehumidifier? [Q14b]*(Circle the number of your answer below.)*

1 You

2 Your landlord

15. Do you have one or more personal computers that you use in your apartment unit?**[Q15]***(Circle the number of your answer below.)*

1 No ▶▶▶ Skip to question 18

2 Yes

16. Of the personal computers that you use at home at least once a month, how many are...*(Circle the appropriate number for each appliance below. If you have more than three, circle three.)*

	None	One	Two	Three or more	
Laptop computers	0	1	2	3	[Q16a]

Desktop computers with a regular monitor	0	1	2	3	[Q16b]
Desktop computers with a flat-panel monitor	0	1	2	3	[Q16c]

17. Altogether, how many hours per week is your computer equipment turned on in your apartment unit? [Q17]

(Circle the number of your answer below.)

- 1 Less than 2 hours per week
- 2 Two to 15 hours per week
- 3 Sixteen to 40 hours per week
- 4 More than 40 hours per week, but not turned on all the time
- 5 Turned on all the time

18. How many of the following home office devices are used at this home?

(Circle the appropriate number for each appliance below. If you have more than three, circle three.)

	None	One	Two	Three or more	
Laser, inkjet, or other computer printer	0	1	2	3	[Q18a]
Stand-alone fax machine	0	1	2	3	[Q18b]
Stand-alone photocopier	0	1	2	3	[Q18c]
Combination fax/copier/scanner	0	1	2	3	[Q18d]

19. Is there any other large equipment that uses a lot of electricity in this home? [Q19]

(Examples: welding equipment, medical equipment, kiln, etc.)

(Circle the number of your answer below.)

- 1 No
- 2 Yes →

Please specify:

[Q19a]

COMFORT IN THE WINTER

20. What type of temperature control for heating do you have in your apartment? [Q20]

(Circle the number of your answer below.)

- 0 You have no control for the temperature of your apartment ▶ ▶ ▶ ▶ Skip to question 24
- 1 Simple on/off switch
- 2 Dial control(s) without temperature settings
- 3 Regular thermostat(s) with temperature settings
- 4 Clock or programmable thermostat(s) →

Do you use the thermostat to automatically change the temperature at different times of the day or night? [Q20a]

(Circle the number of your answer below.)

- 1 No
- 2 Yes

21. This past winter, how often did you or someone in your household change the temperature setting by hand? (For a clock or programmable thermostat, this would temporarily override your automatic settings.) [Q21]

(Circle the number of your answer below.)

- 0 Didn't live in this apartment unit last winter ▶ ▶ ▶ ▶ ▶ Skip to Question 33
- 1 Rarely or never
- 2 A few times a month
- 3 A couple of times a week
- 4 Usually every day →

When did you change the settings by hand?

(Circle all that apply.)

- 1 In the morning [Q21a1]
- 2 At bed time [Q21a2]
- 3 When needed to be more comfortable [Q21a3]

[Code above as "1" if circled, "0" otherwise]

22. Do you know the approximate temperature at which you kept your apartment unit last winter? [Q22]

(Circle the number of your answer below.)

1 Yes → **At what temperature did you keep your apartment unit last winter...**

(write in your answers below.)

- [Q22a1] ...When someone was awake at home? _____ degrees
- [Q22a2] ...During sleeping hours? _____ degrees
- [Q22a3] ...When no one was home? _____ degrees

2 No → **Compared to when you were awake at home, how did you set the heat last winter...**

(circle the number of your answers below.)

	Didn't change the setting	Turned the heat off	Turned the heat down	Turned the heat up	
...During sleeping hours?	1	2	3	4	[Q22b
...When no one was home?	1	2	3	4	[Q22b

23. People don't always agree about what temperature is most comfortable in the winter. Last winter how much of the time did members of your household agree about the temperature setting?

[Q23] *(Circle one number.)*

- 1 Rarely or never agreed
- 2 Sometimes agreed
- 3 Usually agreed
- 4 Always agreed
- 5 Not applicable (there are no other household members)

24. How would you describe the general level of comfort in your apartment unit in the winter? [Q24]

(Circle the number of your answer below.)

- 0 Haven't lived here during the winter yet ▶ ▶ ▶ ▶ ▶ ▶ Skip to Question 33
- 1 Very uncomfortable
- 2 Somewhat uncomfortable
- 3 Somewhat comfortable
- 4 Very comfortable

25. How often do you or other members of your household find your apartment unit too cold or drafty during the winter? [Q25]

(Circle the number of your answer below.)

- 1 Never or rarely ▶▶▶ skip to Question 28
- 2 Some of the time
- 3 Most of the time
- 4 Always

26. How often do you do each of the following when you find your apartment unit too cold or drafty?

(circle the number of your answer for each item below.)

	Never or rarely	Some of the time	Most of the time	Always	
Turn up the thermostat	1	2	3	4	[Q26a]
Turn on a portable heater	1	2	3	4	[Q26b]
Turn on the oven	1	2	3	4	[Q26c]
Start a fire in the fireplace	1	2	3	4	[Q26d]
Put on more clothing or a blanket	1	2	3	4	[Q26e]
Move to a more comfortable part of the apartment	1	2	3	4	[Q26f]
Other (describe: _____)	1	2	3	4	[Q26g]

27. Are there specific places in your apartment unit where—or times when—you or members of your household often feel too cold or feel uncomfortable drafts?

[Q27]

(Circle the number of your answer below.)

- 1 No
- 2 Yes →

Please describe:

_____ [Q27a]

28. How often do you or other members of your household find your apartment unit too hot or stuffy during the winter? [Q28]

(Circle one number.)

- 1 Never or rarely ▶▶▶ skip to Question 31

- 2 Some of the time
- 3 Most of the time
- 4 Always

29. How often do you do each of the following when you find your apartment unit too hot or stuffy in the winter? (Circle the number of your answer for each item below.)

	Never or rarely	Some of the time	Most of the time	Always	
Turn down the thermostat	1	2	3	4	[Q29a]
Open a window or door to the outside	1	2	3	4	[Q29b]
Put on lighter clothing	1	2	3	4	[Q29c]
Move to a more comfortable part of the apartment	1	2	3	4	[Q29d]
Turn on a fan	1	2	3	4	[Q29e]
Other (describe): [Q29f1]	1	2	3	4	[Q29f]

30. Are there any specific places in your apartment unit where—or times when—you or members

of your household often feel too hot or stuffy in the winter? [Q30]

(Circle the number of your answer below.)

- 1 No
2 Yes →

Please describe:

_____ [Q30a]

31. How often do you or other members of your household find your apartment unit too dry during the winter? [Q31]

(Circle the number of your answer below.)

- 1 Never or rarely
2 Some of the time
3 Most of the time
4 Always

32. How often did water bead up or frost form on your windows last winter? [Q32]

(Circle the number of your answer below.)

- 1 Never or rarely
2 Sometimes
3 Often
4 Always

COMFORT IN THE SUMMER

33. Do you have central air conditioning in your apartment unit? [Q33]*(Circle the number of your answer below.)*

- 1 No ▶▶▶▶▶▶ Skip to question 35
2 Yes

34. Which of the following best describes how you control your central air conditioning?**[Q34]***(Circle the number of your answer below.)*

- 1 You have no control for the air conditioning in your apartment unit
2 Regular thermostat(s) with temperature settings
3 Clock or programmable thermostat(s) →

Do you use the thermostat to automatically change the temperature at different times of the day or night?**[Q34a]***(Circle the number of your answer below.)*

- 1 No
2 Yes

35. Do you have one or more room or window air conditioners in your apartment unit?**[Q35]***(Circle the number of your answer below.)*

- 1 No ▶▶▶▶▶▶ If you have central air conditioning, skip to question 36
▶▶▶▶▶▶ If you have no air conditioning at all, skip to question 39
2 Yes →

How many individual room or window units do you have? _____**[Q35a]***(Write in your answer above.)***Who provided the air conditioner(s)? [Q35b]***(Circle the number of your answer below.)*

- 1 You
2 Your landlord
3 You provided some and your landlord provided some

What do you do with your room air conditioner(s) in the winter?*(Circle ALL that apply below)*

- 0 Haven't lived here in the winter [Q35c1]
1 Take the air conditioner(s) out of the window [Q35c2]
2 Leave the air conditioner(s) in the window, but with a cover on [Q35c3]
3 Leave the air conditioner(s) in the window, with no cover [Q35c4]

[Code above as “1” if circled, “0” otherwise]

36. How many rooms do you cool with your air conditioning equipment? [Q36]

(Circle the number of your answer below.)

- 0 Haven't lived here long enough to use the air conditioning ▶ ▶ ▶ ▶ ▶ **Skip to question 39**
- 1 None of the rooms ▶ ▶ ▶ ▶ ▶ **Skip to question 39**
- 2 Some of the rooms
- 3 All the rooms

37. Which of the statements below best describes the way you used your air conditioning last summer? [Q37]

(Circle the number of your answer below.)

- 1 Not used at all ▶ ▶ ▶ ▶ ▶ **Skip to question 39**
- 2 Turned on only a few days or nights when really needed
- 3 Turned on a few times each week
- 4 Turned on just about all summer
- 5 Left it on all the time, and let the thermostat control how much it ran

38. Do you know the approximate temperature at which you kept your apartment unit last summer when you ran your air conditioning? [Q38]

(Circle the number of your answer below.)

- 1 Yes → **At what temperature did you keep your apartment unit last summer...**

(Write in your answers below.)

- [Q38a1] ...When someone was awake at home? _____ degrees
- [Q38a2] ...During sleeping hours? _____ degrees
- [Q38a3] ...When no one was home? _____ degrees

- 2 No → **Compared to when you were awake at home, how did you set the air conditioning last summer...**

(Circle the number of your answer for each item below.)

	Didn't change the setting	Turned it <u>off</u>	Turned it <u>to a</u> <u>warmer</u> setting	Turned it <u>to a</u> <u>cooler</u> setting	
...During sleeping hours?	1	2	3	4	[Q38b1]

...When no one was home? 1 2 3 4 [Q38b2]

39. How would you describe the general level of comfort in your apartment unit in the summer?

[Q39] (Circle the number of your answer below.)

- 0 Haven't lived here long enough to know ▶ ▶ ▶ ▶ ▶ Skip to question 44
- 1 Very uncomfortable
- 2 Somewhat uncomfortable
- 3 Somewhat comfortable
- 4 Very comfortable

40. How often do you or other members of your household find your apartment unit too hot during the summer? [Q40]

(Circle the number of your answer below.)

- 1 Never or rarely ▶ ▶ ▶ ▶ ▶ Skip to question 43
- 2 Some of the time
- 3 Most of the time
- 4 Always

41. How often do you do each of the following when you find your apartment unit too hot?

(Circle the number of your answer for each item below.)

	Never or Rarely	Some of the time	Most of the time	Always	
Turn on the central air conditioner	1	2	3	4	[Q41a]
Turn the central air to a cooler setting	1	2	3	4	[Q41b]
Turn on room air conditioners(s)	1	2	3	4	[Q41c]
Turn the room air conditioner(s) to a cooler setting	1	2	3	4	[Q41d]
Turn on fans	1	2	3	4	[Q41e]
Open windows or doors	1	2	3	4	[Q41f]
Move to a more comfortable part of the house	1	2	3	4	[Q41g]
Close shades/blinds	1	2	3	4	[Q41h]

Other (describe): _____ [Q41i1]	1	2	3	4	[Q41i]
------------------------------------	---	---	---	---	--------

42. Are there specific places in your apartment unit where—or times when—you or members of your household are often hot and uncomfortable? [Q42]

(Circle the number of your answer below.)

- 1 No
- 2 Yes →

Please describe:

_____ [Q42a]

43. How often do you or other members of your household find your apartment unit too cold or clammy during the summer? [Q43]

(Circle the number of your answer below.)

- 1 Never or rarely
- 2 Some of the time
- 3 Most of the time
- 4 Always

COMFORT THROUGHOUT THE YEAR

44. How often are you or is someone in your household uncomfortable with the air quality in your apartment unit in the following ways?

(Circle the number of your answer for each item below.)

	Never or Rarely	Some of the time	Most of the time	Always	
Air smells moldy	1	2	3	4	[Q44a]
Air smells of cooking or other odors	1	2	3	4	[Q44b]
Air is stale	1	2	3	4	[Q44c]

45. How often are you or a member of your household dissatisfied with your hot water in the following ways?

(Circle the number of your answer for each item below.)

	Never or Rarely	Some of the time	Most of the time	Always	
Not enough hot water	1	2	3	4	[Q45a]
Water is not hot enough	1	2	3	4	[Q45b]
Water is too hot	1	2	3	4	[Q45c]
Hot water pressure is too low	1	2	3	4	[Q45d]

46. How often are you or a member of your household dissatisfied with the lighting provided with your apartment unit in the following ways?

(Circle the number of your answer for each item below.)

	Never or Rarely	Some of the time	Most of the time	Always	
Lighting is too dim	1	2	3	4	[Q46a]
Lighting is too bright	1	2	3	4	[Q46b]
Don't like the color or quality of the lighting	1	2	3	4	[Q46c]
Not enough daylight gets in	1	2	3	4	[Q46d]

47. Have you notified your landlord about any of the following comfort problems in your apartment unit during the last year?

(Circle the number of your answer for each item below.)

	No	Yes	
Comfort during the winter	1	2	[Q47a]
Comfort during the summer	1	2	[Q47b]
Odors or indoor air quality problems	1	2	[Q47c]
Problems with the hot water	1	2	[Q47d]
Lighting problems	1	2	[Q47e]

COMFORT IN COMMON AREAS

48. Does your building have common areas such as hallways or entryways that are used by more than one tenant? [Q48]

(Circle the number of your answer below.)

- 1 No ▶▶▶▶▶ Skip to question 51
- 2 Yes

49. How often have you experienced the following comfort problems in the common areas in your building in the last year?

(Circle the number of your answer for each item below.)

	Never or Rarely	Some of the time	Most of the time	Always	
Too cold during the winter	1	2	3	4	[Q49a]
Too hot during the winter	1	2	3	4	[Q49b]

Too cold during the summer	1	2	3	4	[Q49c]
Too hot during the summer	1	2	3	4	[Q49d]
Lingering odors or stale air	1	2	3	4	[Q49e]
Lighting too dim	1	2	3	4	[Q49f]
Lighting too bright	1	2	3	4	[Q49g]
Other (describe: _____ [Q49h1])	1	2	3	4	[Q49h]

50. Have you notified your landlord about any comfort problems with common areas in the last year?

[Q50] (Circle the number of your answer below.)

- 1 No
- 2 Yes

ATTITUDES ABOUT ENERGY

51. We are interested in your attitudes about energy. Below are some statements people have made about energy use. Please tell us how much you agree or disagree with these statements.

(Circle the number of your answer — for each item below.)

	Strongly Disagree	Somewhat Disagree	Somewhat Agree	Strongly Agree	
I'm not interested in making energy-saving improvements to my apartment unit.	1	2	3	4	[Q51a]
It's just not worth putting on more clothing in the winter to try to save a little energy.	1	2	3	4	[Q51b]
I would only conserve energy if I could not afford to pay for it.	1	2	3	4	[Q51c]
My family's health would suffer if our home were not heated to its present temperature.	1	2	3	4	[Q51d]
My annual energy bills don't amount to much compared to my other expenses.	1	2	3	4	[Q51e]
I would be very uncomfortable in the winter if I turned the thermostat setting down three degrees when people are home and awake.	1	2	3	4	[Q51f]
It's my right to use as much energy as I want, as long as I pay for it.	1	2	3	4	[Q51g]
I have to conserve energy in my home because I can't afford to pay higher utility bills.	1	2	3	4	[Q51h]
I would probably get more colds and illnesses if I turned down the thermostat in the winter.	1	2	3	4	[Q51i]
I know what steps I can take to save more energy in my home.	1	2	3	4	[Q51j]
I worry about being poisoned by carbon monoxide from the heating system, water heater, or range in my home.	1	2	3	4	[Q51k]
I have a great deal of control over how energy is used in this home.	1	2	3	4	[Q51l]
I only use electricity when it's really needed; there's no way I could cut down.	1	2	3	4	[Q51m]
Paying the energy bills is a financial hardship for our family.	1	2	3	4	[Q51n]
There's nothing more I can do to cut back on my home's energy use.	1	2	3	4	[Q51o]
My energy bills are about as low as they can get.	1	2	3	4	[Q51p]

ENERGY BILLS

52. How familiar are you with your household's monthly energy bills? [Q52]*(Circle the number of your answer below.)*

- 1 Not very familiar
- 2 Somewhat familiar
- 3 Very familiar

53. Which of the following best describes electricity bills for your apartment unit? [Q53]*(Circle the number of your answer below.)*

- 1 Your landlord pays the bill, and electricity is included in the rent ▶ ▶ ▶ ▶ ▶ Skip to question 54
- 2 You pay an electric bill directly to a utility, and the bill includes only your apartment unit →
- 3 You divide an electric bill other tenants in your building →

Which of the following do you pay for in your electric bill?*(Circle the number of ALL that apply below.)*

- 1 Lights and appliances you plug in [Q53a1]
- 2 Space heating [Q53a2]
- 3 Water heating [Q53a3]
- 4 Range or oven [Q53a4]
- 5 Air conditioning [Q53a5]
- 6** Electric clothes dryer [Q53a6]

*[Code above as "1" if circled, "0" otherwise]***54. Which of the following best describes natural gas bills for your apartment unit?****[Q54]***(Circle the number of your answer below.)*

- 1 You do not use any natural gas ▶ ▶ ▶ ▶ ▶ Skip to question 55
- 2 Your landlord pays the bill, and natural gas is included in the rent ▶ ▶ ▶ ▶ ▶ Skip to question 55
- 3 You pay a natural gas bill directly to a utility, and the bill includes only your apartment unit →
- 4 You divide a natural gas bill with other tenants in your building →

Which of the following do you pay for in your natural gas bill?*(Circle ALL that apply below.)*

- 1 Space heating [Q54a1]
- 2 Water heating [Q54a2]

- 3 Range or oven [Q54a3]
 - 4 Natural gas clothes dryer [Q54a4]
- [Code above as “1” if circled, “0” otherwise]

55. Which of the following best describes propane or fuel oil bills for your apartment unit? [Q55]

(Circle the number of your answer below.)

- 1 You do not use any propane or fuel oil ▶ ▶ ▶ ▶ ▶ **Skip to question 56**
- 2 Your landlord pays the bill, and propane or fuel oil is included in the rent
▶ ▶ ▶ ▶ ▶ **Skip to question 56**
- 3 You pay a propane or fuel oil bill directly to a provider, and the bill includes only your apartment unit →
- 4 You divide a propane or fuel oil bill with other tenants in your building →

bills?

Which of the following do you pay for in your propane or fuel oil

(Circle ALL that apply)

	Propane	Fuel Oil	Neither	
Space Heating	1	2	3	[Q55a1]
Water Heating	1	2	3	[Q55a2]
Range or Oven	1	2	3	[Q55a3]
Clothes Dryer	1	2	3	[Q55a4]

56. Do you use wood to fuel anything in your apartment unit? [Q56]

(Circle the number of your answer below.)

- 1 No
- 2 Yes →

What is fueled by wood?

(Circle the number of your answer for each item below.)

	No	Yes	
Fireplace	1	2	[Q56a1]
Stove	1	2	[Q56a2]
Furnace	1	2	[Q56a3]
Water Heater	1	2	[Q56a4]
Other: _____ [Q56a51]	1	2	[Q56a5]

the wood?

[Q56b] *(Circle the number of your answer below.)*

- 1 You purchase it yourself
- 2 You obtain it yourself for free
- 3 Your landlord provides it

57. Government agencies and utilities have programs to help households who can't pay all of their energy bills. Has your household received this kind of help since moving into this apartment unit? [Q57]

(Circle the number of your answer below.)

- 1 No
- 2 Yes

SAVING ENERGY

58. In your opinion, which of the following statements best describes the opportunities for energy savings in this building that could be taken by the owners or management company? [Q58]

(Circle the number of your answer below.)

- 5 There is little or nothing management could do to further reduce energy costs in this building
- 6 There are a few things management could do to further reduce energy costs in this building
- 7 There are many things management could do to further reduce energy costs in this building
- 8 Don't know

59. In your opinion, which of the following statements best describes the opportunities for energy savings in this building that could be taken by tenants? [Q59]

(Circle the number of your answer below.)

- 5 There is little or nothing tenants could do to further reduce energy costs in this building
- 6 There are a few things tenants could do to further reduce energy costs in this building
- 7 There are many things tenants could do to further reduce energy costs in this building
- 8 Don't know

60. Have you *added* any of the following features to your apartment?

(Circle the number of your answer for each item below.)

	No	Yes	
Caulking or weatherstripping	1	2	[Q60a]
Put up plastic or other insulation on windows	1	2	[Q60b]
Installed low-flow showerheads	1	2	[Q60c]
Installed faucet aerators	1	2	[Q60d]
Wrapped hot water pipe	1	2	[Q60e]
Wrapped water heater	1	2	[Q60f]

Other: _____ [Q60g1] 1 2 [Q60g]

61. How often do you take the following sorts of actions?

(Circle the number of your answer for each item below.)

	Rarely or never	Some of the Time	Most of the Time	Always	Doesn't Apply	
Lower the heating thermostat at night	1	2	3	4	5	[Q61a]
Lower the heating thermostat when you are going away for awhile	1	2	3	4	5	[Q61b]
Limit use of the air conditioner to a few very hot days	1	2	3	4	5	[Q61c]
Turn off unused lights	1	2	3	4	5	[Q61d]
Turn off unwatched televisions	1	2	3	4	5	[Q61e]
Run the dishwasher only when it is full	1	2	3	4	5	[Q61f]
Run the dishwasher on the energy-efficient setting	1	2	3	4	5	[Q61g]
Run the clothes washer only with full loads	1	2	3	4	5	[Q61h]
Use the energy efficiency setting on the microwave	1	2	3	4	5	[Q61i]

62. People take energy-saving actions for different reasons. For each of the following actions, tell us the most important reasons that you take the action. Circle up to three reasons for each item.

(Circle up to three numbers for each item below. If you don't take the action, circle 'Doesn't apply')

	Home comfort	Health and air quality	Save money	Help the Environ- ment	Don't like to waste	Doesn't apply
Use less heat	1 [Q62a1]	2 [Q62a2]	3 [Q62a3]	4 [Q62a4]	5 [Q62a5]	6 [Q62a6]
Use less air conditioning	1 [Q62b1]	2 [Q62b2]	3 [Q62b3]	4 [Q62b4]	5 [Q62b5]	6 [Q62b6]
Turn off lights	1 [Q62c1]	2 [Q62c2]	3 [Q62c3]	4 [Q62c4]	5 [Q62c5]	6 [Q62c6]
Turn off unused	1	2	3	4	5	6

appliances	[Q62d1]	[Q62d2]	[Q62d3]	[Q62d4]	[Q62d5]	[Q62d6]
Run only full dishwasher or laundry loads	1 [Q62e1]	2 [Q62e2]	3 [Q62e3]	4 [Q62e4]	5 [Q62e5]	6 [Q62e6]

[Code above as “1” if circled, “0” otherwise]

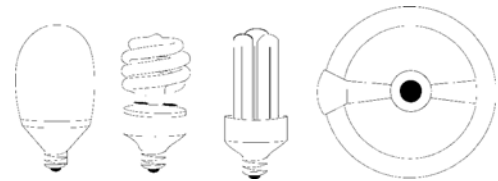
- 63. For each of the actions listed above in Question 62, go back and underline the number of the single most important reason for that action. [Q63a through Q63e]**

64. Have you installed any compact fluorescent lights in your apartment? [Q64]

Compact fluorescent bulbs screw into regular (incandescent) light bulb sockets and come in different styles, such as those shown at right.

(Circle the number of your answer below.)

- 1 No
- 2 Yes
- 3 Not sure



65. What is the most effective thing you could do to save energy in your apartment unit? [Q65]

(Write in your answer below.)

YOUR HOUSEHOLD

66. How many people in each of the following age groups, including yourself, have lived in your household at least 6 months in the past year?

(Fill in the blank for each age group below.)

- _____ 0 to 5 years of age [Q66a]
- _____ 6 to 17 years of age [Q66b]
- _____ 18 to 64 years of age [Q66c]
- _____ 65 or more years of age [Q66d]
- _____ **Total persons in household [Q66e]**

67. What is the highest level of education completed by you and other adults in the household responsible for making household decisions

(Circle the number of your answer below for each adult in the household.)

	You [Q67a]	Adult #2 [Q67b]	Adult #3 [Q67c]	Adult #4 [Q67d]
(Not present in this household)		0	0	0
Grade School	1	1	1	1
Some high school	2	2	2	2
High school graduate or GED	3	3	3	3
Some technical school/junior college	4	4	4	4
Technical school/junior college graduate (Associate degree)	5	5	5	5
Some college but no degree	6	6	6	6

Bachelor's degree	7	7	7	7
Advanced degree	8	8	8	8

68. Would you categorize this household as unrelated adults living as roommates?

[Q68]

(Circle the number of your answer below.)

- 1 No
- 2 Yes

69. How many *hours per week* is a member of this household at home between 8 a.m. and 5 p.m. on weekdays? (There is a total of 45 hours between 8 a.m. and 5 p.m. on weekdays) [Q69]

(write in your answer below.)

Someone is home _____ hours *per week* between 8 a.m. and 5 p.m. on weekdays

70. Which of the following categories best describes the total income of your household in 2001?

[Q70] (Circle the number of your answer below.)

- 1 Less than \$5,000
- 2 \$5,000 to \$9,999
- 3 \$10,000 to \$14,999
- 4 \$15,000 to \$19,999
- 5 \$20,000 to \$24,499
- 6 \$25,000 to \$29,999
- 7 \$30,000 to \$34,999
- 8 \$35,000 to \$49,999
- 9 \$50,000 to \$74,999
- 10 \$75,000 or more

71. Is there anything else you would like to tell us about your home or energy activities?

[Q71]

72. May we contact you in the future if we have questions about this or other studies?

[Q72]

- 1 No
- 2 Yes

Thank you for taking the time to fill out this survey. Your information will help us a great deal in completing our research. Please fill out and sign the attached utility release form, and return both in the attached postage-paid envelope to:

**Wisconsin Rental Housing Energy Use Study
Energy Center of Wisconsin
595 Science Drive, Madison, WI 53711**

Questions and Answers About the Study

Who is conducting this study?

This study is being conducted by the Energy Center of Wisconsin with funding from the State of Wisconsin’s “Focus on Energy” initiative and the Wisconsin utilities. The Energy Center is a private, non-profit organization that conducts research on energy use in Wisconsin. The University of Wisconsin — Milwaukee and Franklin Energy Services are assisting with implementing the study.

What will you do with the information you gather?

The State of Wisconsin and others will use this information to improve programs to help renters save energy. Our goal is to better understand how much energy is used in rental properties and ways to improve energy efficiency in these buildings. We are also interested in how energy use is related to comfort in rental properties.

How was I selected for this study?

Your building was randomly selected as one of a few rental properties in Wisconsin for this study. Your landlord has agreed to participate in an energy audit of the building. As part of our research, we would like to find out what tenants think about energy use and comfort at this location. In most cases, we are asking all tenants in the building to participate by filling out our questionnaire and providing authorization for us to obtain utility usage information. In some large buildings, we select a random sample of tenants for participation.

Why do you want my utility records?

An important part of our study is studying how much energy is used in rental buildings. This means looking at actual usage for utility accounts that tenants pay as well as those paid by landlords. We are interested only in how much energy is used in your building; we do not request payment information from the utilities.

How will you protect the confidentiality of the information I provide?

The responses you provide will not be associated with your name or address in any way. We will not sell, trade, or divulge any personal information that we gather. The only reason we even need to know personal information such as your name and address is so that we can send you a check for \$15 as our way of saying “thank you” for participating.

Whom should I contact with additional questions?

You should contact:

Scott Pigg
Senior Project Manager
Energy Center of Wisconsin
(608) 238-8276, ext. 138
spigg@ecw.org

(to be filled in by field crew)