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GEOS 206

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May 16, 2010

Minifridges = Big Costs?



Figure 1: Common small size minifridge found on college campuses

When considering ways to make college campuses more sustainable, the large, complex issues are generally brought to the table first. Considering ways to overhaul larger institutional structures often leaves little consideration for smaller scale issues that involve changing student behavioral practices. Minifridges in college dorms represent the smaller things that often go overlooked in the grand scheme of college sustainability. While it is unclear exactly how much energy these appliances use, it is important that we consider them and the other small-scale energy users that they represent in our crusade for a green campus. Mini-refrigerators, unlike other small appliances that are used in dorms, are constantly running. Most minifridge owners

only unplug them before long-term breaks (Winter and spring) and often to not take note to the temperature setting during times of use. Considering these things allows one to better understand the importance of knowing how much energy these machines use on a campus wide level. Having this information allows one to consider new alternative options to mini-refrigerator use as well as how to improve the alternative options that might already be available.

Procedure

To gain a sense of how much energy minifridges use on the Williams College campus, I started out at the individual level. I begin by using Kill-a-Watt energy measuring devices to determine the energy being used by various minifridges on campus throughout a one-day period. Upon entering a student's room, I explained my project as thoroughly as possible, giving them an idea of what I was looking for and how the devices work. In addition to connecting the Kill-a-Watt to their minifridge, I noted the current temperature setting of the fridge as well as the size and model. Following these observations, I asked the owners the following questions:

1. Generally, how often do you think that you use the fridge in the course of the day?
2. About how old is the fridge?
3. How often do you change the temperature setting? Do you generally keep the temperature setting consistent throughout the year?
4. Anything else that would be interesting to know about the fridge?

In addition to first hand data, I also conducted research that would give me an idea of general patterns of minifridge use on campus. By looking at the results of an energy use survey

conducted in 2006, I was able to obtain percentage estimates of how many people use minifridges on campus as well as more nuanced information about these refrigerators and their behavioral patterns in relation to these appliances. This information includes the size of their refrigerator, whether their fridge contains a freezer, whether the fridge is rated an energy star appliance and the temperature setting that they use. While the entire campus did not respond to the survey, I applied the percentages of those who responded to the campus at large to make a estimate of the how these numbers translate into Williams' campus as a whole.

Results

Chart 1: Minifridge Energy Use

(Data is in order in which collected starting from May 3, 2010 to May 18, 2010)

Brand	Size	kWh per day	Age (yrs of age)	Special Notes
Kenmore	S	2	≈ 2	Lowest temperature setting, used infrequently, very empty
Danby	S	1.84	≈ 4	Medium temperature setting, used moderately
Kenmore	S	1.18	≈ 3	Medium temperatures setting, used often
Kenmore	S	1.70	≈ 3	Low temperature setting, used often
Haier	S	1.80	≈ 2	Medium temperature setting, used

				infrequently
Haier	S	.41	≈4	Medium temperature setting, used rarely
GE	M	.68	≈2	Used moderately, medium temperature setting
GE	M	.62	≈4	Used moderately, medium temperature setting, full
Whirlpool	S	.54	≈2	Used frequently, generally full, medium temperature setting
Chefmate	S	.51	≈5	Used frequently, medium temperature setting
Chefmate	S	.97	≈3	Rarely used, empty, low temperature setting
Whirlpool	M	.54	≈ 6	Used moderately, medium temperature setting, half full

The chart above shows all of the energy data collected from various minifridges on campus. Overall the average amount of kWh used by a small minifridge everyday was 1.19 kWh/day while medium minifridges used about .64 kWh/day. Most of the fridges were set to the middle temperature setting that owners said were not typically altered. There is a large discrepancy between the minifridges that were measured during the week of May 3rd and those

that were taken in the second week. I will consider the possible sources of this discrepancy in my discussion. The average age of the minifridges evaluated was 3.3 years old. Though the range of ages was small, I could detect no difference in efficiency based on this factor. It seems as though the amount of food in the fridge might have had some affect on its energy consumption. This topic will be explored more in the discussion section as well.

In addition to collecting my own data using the Kill-a-Watt measuring devices, I found the following results from a survey conducted in 2006.¹

Figure 2: Number of Respondents who Own Minifridges

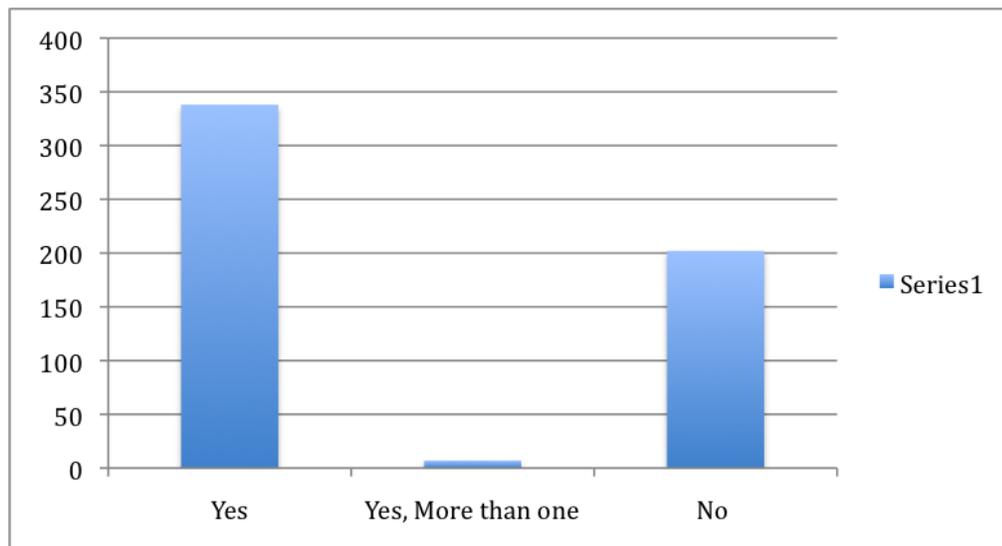


Figure 2: shows that 338 out of 547 respondents own at least one minifridge while 7 actually owned more than one fridge and 202 owned no minifridge at all.

Figure 3: Number of Small versus Medium Size Minifridges on Campus

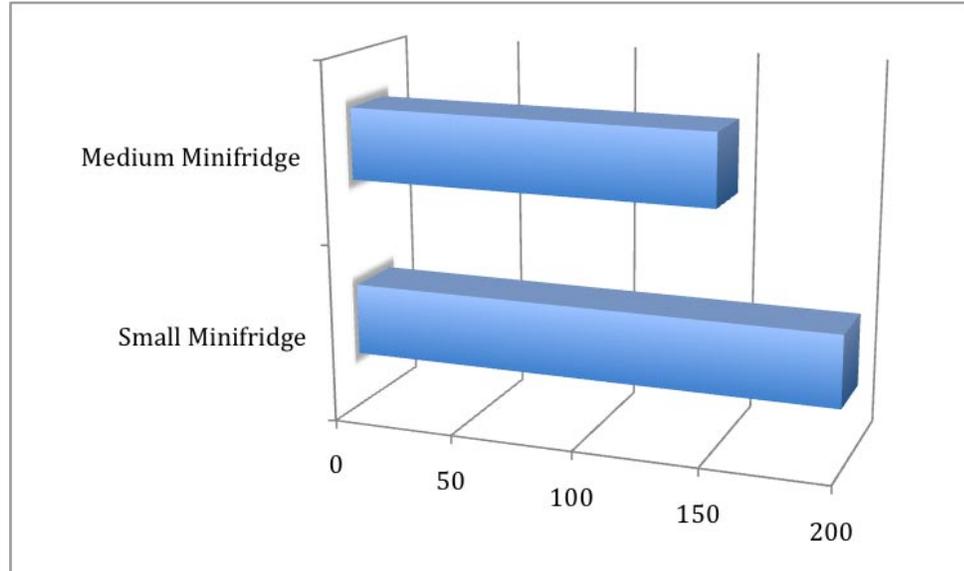


Figure 3 shows the amount of small versus medium sized refrigerators on campus. In this survey, small was defined as less than 18” tall while medium was described as being taller than 18”. Surprisingly, there was only a 14.2 percent difference between small and medium sized minifridges on campus.

Calculations

Using the following numbers from my measurements and the results of the 2006 energy survey I was able to calculate the average amount of energy used by mini-refrigerators of the Williams campus in a typical school year.

- Number of Days in School Year \approx 9 mths-1 mth (winter and spring vacation) \approx 240 days
- Number of Minifridges on campus \approx (2100 students)(61.8%) \approx 1298
- Number of small minifridges of campus \approx 741
- Number of medium minifridges \approx 557
- Electricity Rate \approx .13/kWh

- Average electricity consumed by small minifridge ≈ 1.19 kWh/day
- Average electricity consumed by medium minifridge $\approx .64$ kWh/day

$$(741 \text{ small fridges})(1.19 \text{ kWh/day}) = 881.79 \text{ kWh total /day}$$

$$(881.79 \text{ kWh/day})(270 \text{ days}) = 211,629.6 \text{ kWh/year}$$

$$(211,629.6 \text{ kWh/year})(0.13 \text{ dollars}) = \$27,511.85 \text{ total spent in electricity for Small minifridges per year}$$

$$(557 \text{ medium fridges})(.64 \text{ kWh/day}) = 356.48 \text{ kWh/day}$$

$$(356.48)(240) = 85555.2 \text{ kWh/year}$$

$$(85555.2)(0.13 \text{ dollars}) = \$11,122.18 \text{ spent on electricity for medium minifridges per year}$$

$$211,629.6 \text{ kWh/year} + 85,555.2 \text{ kWh/year} = \mathbf{297,184.8 \text{ kWh/year}}$$

$$\$11,122.18 + \$27,511.85 = \mathbf{\$38,634.07}$$

Thus, minifridges on the Williams College campus consume a total of about kWh/year resulting in about \$38,634.07. Considering that the college generally consumes around 22,289,777 kWh of electricity in total over the course of the year, minifridges make up about 1.5% percent of total electricity consumption on the campus.

Conclusion

Considering the grand scheme of electricity on campus, minifridges do not make up a significant portion the money spent on electricity. This does not mean, however, that it is not important to pursue a decrease in their consumption. Because minifridge energy consumption on campus is related to student behavior, considering way to reduce their consumption would allow for insight in how to affect student behavioral practices in other areas as well.

Discussion

Sources of Error

It does not seem logical that the medium-sized minifridges would consume less energy on average than their small counterparts. While it is possible that all three medium minifridges from which I collected data were energy star and thus consumed way less energy on average, my results were probably more affected by the large difference in data from the first week to the second week. Due to the discrepancy in data from the first week to the second week, the average for the different size models were affected. In order to fix this problem it is necessary to consider ways to fix this data problem.

Initially, the only factor that seemed to have possible caused the abrupt shift in data was time. I began thinking of how collected data in two different weeks could have cause such a change in the numbers. After researching how climate affects the energy consumption of fridges and finding that the effect was insignificant, I began brainstorming other possible causes. After retesting two of the fridges that were tested in the first week and getting results that were similar to those recently collected, I concluded that the different time of measurement was likely a coincidence and other factors were to blame for the large difference. These possible differences could have been better explored with more detailed account of each fridge measured. This ideas is discussed below.

Ways to Improve

If given the opportunity to explore this subject further, I would be interested to collect data from a larger variety of refrigerators on campus in order to focus in on the specific details of each minifridge measured. During this process, I consistently came across more and more nuances that could possibly affect the amount of energy used. When I began the project, I

planned to assess minifridges primarily on their size, not anticipating the multiplicity of other factors that would influence the data. Creating a more precise profile for the minifridges that I measure would allow me to really track down the factors that make a significant contribution to the amount of electricity that minifridges consume.

Some of these factors could be the placement of the fridge in the room as well as the amount of food in the refrigerator during the time of measurement. When offering advice on how to make household appliances most energy efficient, appliance manufacturers recommend that fridges be kept a fair distance away from any walls or cabinets as to allow air to circulate around the condenser coils.ⁱⁱ In the event that heat becomes trapped, it can cause the fridge to use much more energy. Perhaps paying attention to how fridges are placed in rooms could prove beneficial.

In addition, companies also advise consumer's to purchase refrigerators that are the appropriate size for the amount of food that it will be holding. Refrigerators are most efficient at cooling when they are full. If they are too full, however, air circulation may be limited. Bringing this advice back to college campuses, it would be interesting to explore how much students actually store in their fridges on a regular basis. Though I did not take special note of the amount of contents in each individual fridge, I did mark those who held very few items. While not showing significant differences in energy consumption, it would be worthwhile to monitor the relationship between the amount of contents in the fridge and the amount of electricity being used. Exploring these nuances would allow me to make sense of the peculiar difference between data taken from the first to the second week and consequently account for the supposed larger energy consumption rate of larger fridges.

Exploring Alternative Options

Despite minifridges only making up 1.3% of the total electricity consumed at Williams over the course of the year, it is still important to consider the ways in which their impact can be reduced. The first alternative to minifridges that comes to mind is providing larger communal fridges in their place.

Chart 2: Willingness to Share Fridge

Scale of Willingness	Absolutely Unwilling										Completely Willing
Number of Respondents	38	37	47	43	33	44	27	22	19	10	23
Percentage	11.1	10.8	13.7	12.5	9.6	12.8	7.9	6.4	5.5	2.9	6.7

Chart 2 shows that most of the campus is reluctant to the idea of sharing a fridge with other individuals. Because most dorms on the Williams campus have large communal fridges for residents to store food, it is important to consider why this resource is not being used by a majority of students on campus. In conducting informal research on this topic, I found that the main reason that communal fridges go unused by a majority of the campus is out of fear that food will be taken. In response to being asked why she didn't make use of the communal fridge, a Fayeweather resident responded saying, "I think most people don't use the fridge downstairs because they think someone is going to eat their food. You write your name of stuff so that people won't take it and it still ends up gone. Especially on the weekend, when people are partying down there. By the end of the night when they get hungry, they could care less if your

name is on it or not.” This comment reflects the general consensus on communal fridges though some showed an adversity to most communal fridges being located on the first level of the building, making in inconvenient for students living on upper level floors.

Taking these communal fridge concerns into consideration, we begin to see the ways in which the communal fridge system could be strengthened. They would perhaps be more frequently used if there were one located on each floor rather than simply having one in the basement. One person commented on their freshman year experience with communal fridges in the Mission dorm. He felt that because a smaller group (the entry) was intended to use the fridge, it felt safer, more personal than the communal fridges that are found in most upperclassman dorms. Placing a community fridge on the each floor of the building might allow fridges to appear safer and appeal more to residents. Realistically speaking, the layout of most doors would probably not allow for this to be implemented. Many of the hallways in upperclassmen dorms are very narrow and have very little space for a refrigerator to be put. In addition, it would be necessary to figure out whether this increase in large communal fridges would offset the savings of individual minifridges. In the event that the energy consumption of the additional large fridges was greater than that of the various minifridges on campus, there would be little reason to implement this plan. Though this plan might not be practical, it is demonstrative of the kind of the private, safe feel that communal refrigerators must have in order for their use to be increased.

One way to accomplish this feel without adding more communal fridges would be to promote a community feel within dorms on campus. Because the residents of larger dorms typically do not know each other and very rarely interact, it is difficult to trust those with whom one is sharing the fridge. Perhaps the green movement on campus could be used to promote a collective spirit within the dorms that would make residents more comfortable with leaving their

food in the communal fridge. Furthermore, if residents feel more closely connected to those with whom they live, they are less likely to take food that does not belong to them. Because attempts at garnering community spirit have been made in the past through campaigns such as “Do It in The Dark”, it is important to consider the ways in which these kinds of programs can be strengthened and become staples of the Williams community.

In order to accomplish this, it is important to get freshmen involved so that they will carry the spirit on to upperclassman housing. In order to do this, perhaps junior advisors and other authoritative figures with whom freshman makes lots of contact (admissions counselors, Ephventures leaders, etc) during their first days on campus can be used in order to establish Williams’ dedication to the environment in their minds. Along the same lines the Baxter Fellows of the upperclassmen dorms could be asked to do more to promote house unity around environmental issues as well.

Rather than considering ways in which to decrease the number of minifridges on campus, we can also consider the ways in which to replace the current fridges on campus with more energy efficient ones. Some schools allow student to rent minifridges for the school year rather than having to bring their own to campus. Williams could implement a program such as this with more energy efficient minifridges than the one’s the students typically buy. The feasibility of this program really depends the length of time that it would take to see a return in investment.. Searching around online, I found that the average price for a small (> 18” tall) minifridge is about \$150.00. In order to accommodate all of the current minifridge users on campus, it would require an initial investment of about \$194,700. **Chart 3ⁱⁱⁱ**, located at the end of this document, shows that energy savings from energy star rated minifridges range from 20%-48%.

$$(\$38.634.07 / \text{year}) - (34\%) = \$13.135.58 \text{ total savings in electricity per year}$$

If we use the median to calculate the potential savings of loaning out energy efficient fridges, we can estimate that the school would save about 13,135 dollars in electricity per year by loaning out energy star fridges. Taking the initial \$194,700 investment into account, allows us to determine how long it would take to get a return.

$$\$197,700 / \$13,135.58 = 14.8 \text{ years for return}$$

Some larger universities such as Carnegie Mellon charge students about \$160.00 a year to rent the minifridges.^{iv} If Williams was to implement a similar charge they could greatly offset their investment and shorten the payback period. The model of minifridge used at Carnegie Mellon has a said market value of \$460.00; it would be unreasonable to charge students the same amount for fridges with a market value of 150.00. Considering that Carnegie Mellon charges students about 35% of the retail value of the fridge, perhaps it would be reasonable to charge students about \$52.50 per year to rent a fridge.

$$(\$52.50)(1298 \text{ fridges}) = \$68, 145 \text{ per year}$$

Thus, by charging students \$52.50 to rent energy efficient minifridges, it would make \$68, 145 per year to offset the initial investment and see a faster return. Furthermore, assuming that the fridges remain in working condition longer than this time, the college would eventually see profit not only from energy savings but the money paid for rental alone.

ENERGY STAR Qualified Refrigerators

ENERGY STAR Qualified Refrigerators & Freezers

Last Modified: 06/17/2009 LISTED IN DESCENDING ORDER, WITH LOWEST ENERGY USERS FIRST (REFER TO COLUMN I)

Definitions of Terms Used in Column Headers go to http://www.energystar.gov/index.cfm?i=usaaction=refrig_display_column_definitions

Brand	Model	Configuration	Defrost Type	Compact	Ice	Volume	Adjusted Volume	kWh/year	Federal Standard (kWh/year)	Percent Better	Active	Active Date
Sub-Zero, Inc.	UC24RO*	Refrigerator Only - Single Door	Automatic	Yes	No	5.67	5.67	223	427	48%	Yes	7/18/2008
U-Line	217SR	Refrigerator Only - Single Door	Automatic	Yes	No	5.5	5.50	246	425	42%	Yes	7/18/2008
Danby	DCR059*	Refrigerator/Freezer - Single Door	Manual	Yes	No	1.7	1.74	252	318	21%	Yes	5/6/2009
Kenmore	461.98262	Refrigerator/Freezer - Single Door	Manual	Yes	No	1.7	1.74	252	318	21%	Yes	5/6/2009
Sunbeam	SBR039WE	Refrigerator/Freezer - Single Door	Manual	Yes	No	1.66	1.87	252	319	21%	Yes	5/6/2009
Kenmore	461.27432	Upright Freezer	Manual	Yes	No	4.24	7.34	258	323	20%	Yes	5/6/2009
U-Line	1179R	Refrigerator Only - Single Door	Automatic	Yes	No	5.5	5.50	259	425	39%	Yes	5/10/2006
MacroFridge	MHR-27E	Refrigerator Only - Single Door	Manual	Yes	No	2.7	2.70	260	328	21%	Yes	5/28/2004
Black & Decker	BCE27	Refrigerator/Freezer - Single Door	Manual	Yes	No	2.7	2.82	261	329	21%	Yes	3/16/2009
Haier	ESRB03B	Refrigerator Only - Single Door	Manual	Yes	No	2.7	2.70	261	328	20%	Yes	8/5/2008
Haier	ESRB03SS	Refrigerator Only - Single Door	Manual	Yes	No	2.7	2.70	261	328	20%	Yes	8/5/2008
Haier	ESRB03VS	Refrigerator Only - Single Door	Manual	Yes	No	2.7	2.70	261	328	20%	Yes	8/5/2008
Haier	ESRB03W	Refrigerator Only - Single Door	Manual	Yes	No	2.7	2.70	261	328	20%	Yes	8/5/2008
MacroFridge	5.6MFR*	Refrigerator/Freezer - Single Door	Manual	Yes	No	5.66	5.87	268	362	26%	Yes	1/8/2009
MacroFridge	MF-5.6XNTP	Refrigerator Only - Single Door	Manual	Yes	No	5.66	5.66	268	358	25%	Yes	2/27/2008
MacroFridge	MF-5.6XNWTTP	Refrigerator Only - Single Door	Manual	Yes	No	5.66	5.66	268	358	25%	Yes	2/27/2008
MacroFridge	MFR-5.6	Refrigerator Only - Single Door	Manual	Yes	No	5.6	5.56	268	358	25%	Yes	5/20/2008
MacroFridge	MFR-5.6W	Refrigerator Only - Single Door	Manual	Yes	No	5.6	5.56	268	358	25%	Yes	5/20/2008
Haier	ESR042PBB	Refrigerator Only - Single Door	Manual	Yes	No	4.1	4.10	270	343	21%	Yes	7/13/2007
Haier	ESR042PWW	Refrigerator Only - Single Door	Manual	Yes	No	4.1	4.10	270	343	21%	Yes	7/13/2007
Black & Decker	BCE46	Refrigerator/Freezer - Single Door	Manual	Yes	No	4.5	4.72	274	350	22%	Yes	3/16/2009
Haier	ESRN046BB	Refrigerator Only - Single Door	Manual	Yes	No	4.6	4.60	274	348	21%	Yes	7/7/2008
Avanti	BCA180W-1	Refrigerator Only - Single Door	Automatic	Yes	No	1.7	1.70	278	377	26%	Yes	6/2/2009
Avanti	BCA180B-1	Refrigerator Only - Single Door	Automatic	Yes	No	1.7	1.70	278	377	26%	Yes	6/2/2009
Avanti	BCA180ZSS-1	Refrigerator Only - Single Door	Automatic	Yes	No	1.7	1.70	278	377	26%	Yes	6/2/2009
Sub-Zero, Inc.	249RP*	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	278	417	33%	Yes	2/21/2003
Ascocold	ARD298C-10RL	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	6/4/2003
MacroFridge	2.9MFR*	Top Freezer	Partial	Yes	No	2.87	3.34	290	421	31%	Yes	1/8/2009
MacroFridge	MF-3XNTP	Top Freezer	Partial	Yes	No	2.9	3.24	290	421	31%	Yes	2/24/2004
MacroFridge	MFR-3	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	5/20/2008
MacroFridge	MFR-3CB	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	5/20/2008
MacroFridge	MFR-3S	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	5/20/2008
MacroFridge	MFR-3WL	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	5/20/2008
MacroFridge	MFR-3WR	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	5/20/2008
Summit	CP-35*	Top Freezer	Partial	Yes	No	2.9	3.34	290	421	31%	Yes	8/9/2004

ENERGY STAR Qualified Refrigerators

Definitions of Terms Used in Column Headers go to http://www.energystar.gov/index.cfm?useaction=efridge.display_column_definitions													
Dany Millennium	DAR194BL	Refrigerator Only - Single Door	Automatic	Yes	No	1.8	1.80	302	378	20%	Yes	8/12/2005	
Dany Millennium	DAR194W	Refrigerator Only - Single Door	Automatic	Yes	No	1.8	1.80	302	378	20%	Yes	8/12/2005	
Silhouette	DAR195BL	Refrigerator Only - Single Door	Automatic	Yes	No	1.8	1.80	302	378	20%	Yes	8/12/2005	
Silhouette	DAR195W	Refrigerator Only - Single Door	Automatic	Yes	No	1.8	1.80	302	378	20%	Yes	8/12/2005	
U-Line	2115R	Refrigerator Only - Single Door	Automatic	Yes	No	3.1	3.10	304	394	23%	Yes	7/18/2006	
U-Line	75R	Refrigerator Only - Single Door	Automatic	Yes	No	5.7	5.70	305	427	29%	Yes	8/6/1999	
U-Line	2015R	Refrigerator Only - Single Door	Automatic	Yes	No	3.1	3.10	307	394	22%	Yes	3/28/2003	
Dany Millennium	DAR254BL	Refrigerator Only - Single Door	Automatic	Yes	No	2.5	2.50	309	387	20%	Yes	8/12/2005	
Dany Millennium	DAR254W	Refrigerator Only - Single Door	Automatic	Yes	No	2.5	2.50	309	387	20%	Yes	8/12/2005	
Silhouette	DAR259BL	Refrigerator Only - Single Door	Automatic	Yes	No	2.5	2.50	309	387	20%	Yes	8/12/2005	
Silhouette	DAR259W	Refrigerator Only - Single Door	Automatic	Yes	No	2.5	2.50	309	387	20%	Yes	8/12/2005	
Perlick	HR	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	311	417	25%	Yes	1/20/2005	
U-Line	15R	Refrigerator Only - Single Door	Automatic	Yes	No	3.5	3.50	312	399	22%	Yes	8/6/1999	
U-Line	29R	Refrigerator Only - Single Door	Automatic	Yes	No	3.5	3.50	312	399	22%	Yes	8/5/1999	
General Electric	SFR03BAP	Refrigerator Only - Single Door	Automatic	Yes	No	3.2	3.20	316	396	20%	Yes	6/12/2004	
General Electric	SFR03BAPB	Refrigerator Only - Single Door	Automatic	Yes	Yes	3.2	3.20	316	396	20%	No	3/4/2004	
General Electric	SFR03BAPBW	Refrigerator Only - Single Door	Automatic	Yes	Yes	3.2	3.20	316	396	20%	No	3/4/2004	
General Electric	SFR03BAPW	Refrigerator Only - Single Door	Automatic	Yes	Yes	3.2	3.20	316	396	20%	No	3/4/2004	
Kennore	94499100	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	316	417	24%	Yes	8/4/2004	
Kennore	94597400	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	316	417	24%	Yes	8/9/2004	
Kennore	95497400	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	316	417	24%	Yes	8/9/2004	
Sanyo	SR-4911*	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	316	417	24%	Yes	7/28/2004	
Sanyo	SR-4912*	Refrigerator Only - Single Door	Automatic	Yes	No	4.9	4.90	316	417	24%	Yes	6/6/2005	
Silhouette	DAR340BL	Refrigerator Only - Single Door	Automatic	Yes	No	3.3	3.30	316	397	20%	Yes	8/12/2005	
Silhouette	DAR340W	Refrigerator Only - Single Door	Automatic	Yes	No	3.3	3.30	316	397	20%	Yes	8/12/2005	
Daor	DF24LS	Refrigerator Only - Single Door	Automatic	Yes	No	5	5.00	321	419	23%	Yes	6/29/2007	
Daor	DF24RS	Refrigerator Only - Single Door	Automatic	Yes	No	5	5.00	321	419	23%	Yes	6/29/2007	
Avanti	BCA4560W-2	Refrigerator Freezer - Single Door	Automatic	Yes	No	4.5	4.50	324	412	21%	Yes	3/27/2009	
Avanti	BCA4561B-2	Refrigerator Freezer - Single Door	Automatic	Yes	No	4.5	4.50	324	412	21%	Yes	3/27/2009	
Avanti	BCA4562SS-2	Refrigerator Only - Single Door	Automatic	Yes	No	4.5	4.50	324	412	21%	Yes	3/27/2009	
Jenn-Air	JUD248RC**	Refrigerator Only - Single Door	Automatic	Yes	No	5.1	5.10	325	420	23%	Yes	4/9/2008	
KitchenAid	KOD24V*	Refrigerator Only - Single Door	Automatic	Yes	No	5.1	5.10	325	420	23%	Yes	4/9/2008	
KitchenAid	MFR4-4GF	Refrigerator Only - Single Door	Automatic	Yes	No	4.4	4.40	325	411	21%	Yes	5/20/2008	
KitchenAid	MFR4-4GF-BUD	Refrigerator Only - Single Door	Automatic	Yes	No	4.4	4.40	325	411	21%	Yes	5/20/2008	
MacroFridge	4.4MFR4*	Refrigerator Only - Single Door	Automatic	Yes	No	4.37	4.37	326	410	21%	Yes	5/20/2008	
MacroFridge	MFR4-4	Refrigerator Only - Single Door	Automatic	Yes	No	4.4	4.37	326	410	21%	Yes	1/8/2009	
Sanyo	SR-4460*	Refrigerator Only - Single Door	Automatic	Yes	No	4.4	4.40	326	411	21%	Yes	12/16/2003	
Dany	DKC45BL5	Refrigerator Only - Single Door	Automatic	Yes	No	5.8	5.80	328	429	23%	Yes	7/28/2004	
KitchenAid	KBCA06XP	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	328	422	22%	Yes	8/12/2005	

ENERGY STAR Qualified Refrigerators

Definitions of Terms Used in Column Headers go to http://www.energystar.gov/index.cfm?useaction=efrfrg.display_column_definitions													
Model	Product Type	Energy Star Label											
KitchenAid	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	328	422			22%	Yes	8/2/2005
Dany Designer	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Designer	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Millennium	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Millennium	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Millennium	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Millennium	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Millennium	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany Millennium	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Silhouette	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Silhouette	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Silhouette	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Silhouette	Refrigerator Only - Single Door	Automatic	Yes	N/A	4.4	4.40	329	411			20%	Yes	8/12/2005
Dany	Top Freezer	Partial	Yes	No	3.12	3.74	337	424			21%	Yes	2/11/2009
EdgeStar	Top Freezer	Partial	Yes	No	3.1	3.73	337	424			21%	Yes	12/12/2008
Jenn-Air	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	337	422			20%	Yes	8/2/2007
Jenn-Air	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	337	422			20%	Yes	8/2/2007
KitchenAid	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	337	422			20%	Yes	8/2/2007
KitchenAid	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	337	422			20%	Yes	8/2/2007
KitchenAid	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	337	422			20%	Yes	5/25/2006
KitchenAid	Refrigerator Only - Single Door	Automatic	Yes	No	5.3	5.30	337	422			20%	Yes	5/25/2006
Jenn-Air	Refrigerator Only - Single Door	Automatic	Yes	No	5.7	5.69	338	427			21%	Yes	1/31/2007
KitchenAid	Refrigerator Only - Single Door	Automatic	Yes	No	5.7	5.70	338	427			21%	Yes	4/25/2006
U-Line	Refrigerator Only - Single Door	Automatic	Yes	No	5.5	5.50	339	425			20%	Yes	3/28/2003

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http://www.surveymonkey.com/sr.aspx?sm=_2fSaJP9PXNPQjbDc24JhrL_2fDyoaijUHxtHa_2fZGVtD_2b28_3d

ii <http://www.consumerenergycenter.org/home/appliances/refrigerators.html>

iii <http://www.bowdoin.edu/sustainability/student-involvement/energy-conservation/energy-star-rated-mini-fridges.shtml>

iv <http://www.housing.cmu.edu/FirstYear/microfridge.htm>