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Japanese Refrigerators
A Field Performance Analysis
Final Report

Prepared for
Bonneville Power Administration
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Lambert Engineering, Inc.

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Bonneville Power Administration Perspective
JAPANESE REFRIGERATORS: A FIELD PERFORMANCE ANALYSIS
FINAL REPORT

Project Objective and Background

The Pacific Northwest Electric Power Planning and Conservation Act, signed into law December 5, 1980, mandated regionwide energy conservation practices. Under the act, BPA must identify and implement cost-effective electric energy options and programs for the Pacific Northwest. The Residential Technology Section in the Division of Resource Management supports current residential energy conservation programs and designs and conducts various research and development projects, of which this project is one.

Laboratory test procedures used by the Japanese had shown their refrigerators to be about 50 percent more efficient than American-made refrigerators. A previous BPA study tested 12 Japanese refrigerators according to the U.S. DOE laboratory procedure. When tested to the DOE procedure, Japanese refrigerators used about 43 percent more energy than when tested by the Japanese procedure.

This study compared in-home energy use of 12 Japanese refrigerators identical to those in the laboratory test to both the Japanese and U.S. DOE laboratory tests.

Project Approach

To test in-home energy use, the 12 Japanese refrigerators were placed in the homes of BPA employees in the Portland/Vancouver area and used as the primary refrigerator for 18 months.

Data was recorded manually by homeowners and included:

- cumulative energy use
- cumulative door openings
- winter thermostat setting
- number of occupants at the beginning of the test
- any special applicable events

All collected data was entered into a computer spreadsheet and analyzed to produce this report.

Conclusions

Japanese refrigerators use about 43 percent more energy with the U.S. DOE laboratory test than with the Japanese laboratory test. In the Portland/Vancouver area, the in-home energy use for refrigerators without anti-sweat switches was 15 percent higher than predicted by the Japanese test procedure and 25 percent lower than predicted by the DOE test procedure. Other studies also suggest that the DOE test procedure tends to overpredict in-home energy use. The refrigerators with anti-sweat switches used 2 to 13 percent more energy than the DOE test.

The DOE test procedure had a higher correlation with in-home energy use than the Japanese procedure.

As shown in other studies, this study also had a low correlation of energy use with the number of door openings.

Although kitchen temperature was not recorded for most of the study, the peak monthly energy use occurred in July and August and the peak weekly energy use often occurred during these months. This suggests that refrigerator energy use is sensitive to kitchen temperature. Other studies have shown a high correlation of energy use with kitchen temperature. There was also a relatively high correlation of energy use with outside temperature.

(FOR ADDITIONAL INFORMATION, contact Roy Reinhart at the Residential Technology Section, Bonneville Power Administration, P.O. Box 3621, Portland, Oregon 97208-3621.)

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EXECUTIVE SUMMARY

This report presents and analyzes roughly 18 months of field data on 12 Japanese refrigerators, including 3 matched pairs. Selected Bonneville Power Administration (BPA) employees used these refrigerators in Portland OR and Vancouver WA. The appendix displays graphical representations of individual refrigerator energy use.

Manual data collection occurred roughly every week providing:

- Cumulative energy use.
- Cumulative door openings.
- Thermostat set point (winter only).
- Number of occupants (stated at beginning of test).
- Record of any special applicable events.

Actual data collection intervals ranged from 4 days to several weeks or even months. Data normalization to 7-day weeks eliminated this source of error.

Data analysis produced the following results:

1. Multivariate regression of Department of Energy (DOE) test results and outside temperature with energy consumption gives this equation.

$$\text{Field KWH/day} = (.00323 * \text{DOE}) + (.0183 * \text{Out.Temp.}) - 1.900$$

$$r^2 = 0.87$$

Out.Temp. is average daily outside temperature in degrees F.
DOE is DOE predicted energy use in KWH/yr.

2. Regressing average annual energy consumption with Department of Energy (DOE) test results gives a high r^2 of 0.91.

$$\text{Field KWH/yr} = (1.2 * \text{DOE}) - 322 \text{KWH/yr}$$

$$r^2 = 0.91$$

3. Regressing average daily energy consumption per month with average monthly outside temperature gives an r^2 of 0.86.
4. DOE tests predict actual annual energy usage more accurately than Japanese tests. ($r^2 = 0.91$ DOE vs. $r^2 = 0.85$ Japanese)
5. Peak monthly energy usage occurs in July and August.

6. Peak weekly energy use is frequently in July or August but often results from an extraordinary usage, i.e. making ice sculptures, etc.
7. Average annual energy consumption averaged 16% below DOE predictions (25% below DOE predictions when not including refrigerators with anti-sweat switches.).
8. Average annual energy consumption averaged 25% over Japanese predictions (15% over Japanese predictions when not including refrigerators with anti-sweat switches.).
9. Refrigerators with anti-sweat switches exceeded DOE predictions by 2 - 13%.
10. Regression of door counts with energy use gave very low r^2 values (averaging 0.10) with sufficient valid data.
11. Number of occupants and thermostat set points both showed very low correlations with energy use. Obtaining meaningful data for these particular correlations from such a small sample requires more detailed monitoring and/or better controls on variables.

Results agree substantially with findings published in other studies. Energy use varies linearly with outside temperature essentially independent of refrigerator door openings. Our derived equation uses both DOE predicted consumption and outside temperature for predicting performance of different refrigerators in varying climates.

BACKGROUND AND GOALS

Society generally expects Japanese refrigerators to be more energy efficient than their American-made counterparts. With increasing attention being focused on appliance energy efficiency, research into operating characteristics of Japanese refrigerators has gained importance.

Other projects report the monitored energy use of certain models of Japanese refrigerators.^{1,2} In addition, laboratory tests determined energy consumption of certain refrigerators under controlled conditions.³

In 1987, Bonneville Power Administration (BPA) undertook a project to measure and analyze the energy consumption of 12 Japanese-made refrigerators in the Portland-Vancouver metropolitan area. This project's purpose was to collect field data on certain models and compare with that collected in other projects and laboratory tests.

Twelve BPA employees placed Japanese refrigerators in their homes for 18 months. Installed sensors on each refrigerator measured energy consumption in kilowatt-hours (KWH) and door openings (in counts). BPA asked the twelve participants to mail in completed monitoring cards weekly for 18 months.

The information on the card included: site identification number, meter reading for refrigerator energy consumption, door counter number, kitchen air temperature, and any comments the participant felt pertinent to the project. Data from the cards was input into a Lotus spreadsheet for analysis. BPA issued a preliminary analysis of the data in March, 1989.

This study determines weekly, monthly and annual average and peak energy consumption of Japanese refrigerators in 'real world' settings. Comparisons relate these figures to tested values from DOE and Japanese manufacturers. Since DOE and Japanese test procedures and outcomes differ drastically, relationships between these and actual energy usage appear useful. With two different test standards, comparison of labeled energy consumption by consumers becomes futile.

Japanese energy consumption figures fall 30-40% below those of DOE.³ This energy savings, if real, could substantially cut baseload power for utilities. Determining typical refrigerator energy use patterns and which environmental factors effect them helps utilities to forecast demand.

Objectives for this study include determining accuracy of DOE and Japanese test results for predicting field energy use. Also, consideration of environmental conditions should provide more accurate prediction equations.

TECHNICAL APPROACH

Data collection on twelve Japanese refrigerators took place from roughly July 1987 to January 1989. Bonneville Power Administration employees used the refrigerators and collected weekly data. Data included:

- Energy consumption.
- Number of door openings.
- Kitchen thermostat temperature in winter.
- Number of occupants.
- Record of any special applicable events.

Table 1 shows a brief description of the refrigerators tested.

Sample periods tend to vary by many days in manually gathered data. This variability diminished after non-disruptive data normalization and reconstruction into seven day weeks. Weekly averages derived from total power for a period replaced missing data. Weekly correlations did not use data containing over two weeks of filled data. Monthly correlations did not use data containing over two months of filled data.

Subtracting the previous week's reading from the present week's produced weekly energy consumption and weekly door counts. Inspection of this data pinpointed some obvious data entry errors. Errors were corrected. In cases of meter resets or failures, data remained discontinuous.

Running sums calculated annual energy consumption for each refrigerator. The first sum represented total energy consumption for weeks 1-52, the next for weeks 2-53, and so on, through the final week of data collection. These sums did not begin or end with more than two weeks of filled data.

Refer to "Japanese Refrigerators Field Test Data Analysis" by Peter E. Nelson⁶ for more detailed discussion of these data compilation methods.

Table 1 Description of Refrigerators Tested

SITE #	BRAND	MODEL	FEATURES	# OF DOORS	SIZE C/F (LITERS)
531	Sanyo	457FBA	TF	2	19.6(555)
532	Sanyo	457FBA	TF	2	19.6(555)
533	Hitachi	R-951SB	SS(sw)	2	17.4(492)
534	Hitachi	R-951SB	SS(sw)	2	17.4(492)
535	National	NR455ER-W	SS	3	16.0(453)
536	National	NR455ER-W	SS	3	16.0(453)
537	National	NR434HV-W	TF	2	14.9(422)
538	Mitsubishi	MR4236W	TF	2	15.0(424)
539	Hitachi	R-942SID	SS(ice sw)	2	14.8(419)
540	Hitachi	R-316KV	TF	3	10.2(289)
541	National	NR346HV-W	TF	3	11.5(325)
542	National	NR306CG-W	SS	4	10.7(306)

KEY: TF = TOP FREEZER
SS = SIDE BY SIDE
ice = AUTOMATIC ICE MAKER
sw = ANTI-SWEAT SWITCH

RESULTS

Comparisons of field results with DOE and Japanese (Japan) test results were done. Japanese tests measure energy consumption with a food load, door openings, and two ambient temperatures. DOE tests measure energy consumption at 90 degrees F ambient temperature with no door openings or food load. Each test intends to provide the consumer with a means of comparing energy consumption between different units, though results of the two tests on the same refrigerator differ substantially. Alan Meier provides more details on these tests in his report "Energy Use Test Procedures for Appliances: A Case Study of Japanese Refrigerators".³

Average Annual Energy Consumption

Average annual energy consumption was calculated by averaging as many periods of 52 consecutive weeks as possible. Periods ending or beginning largely with filled data were not used. Tables 2 & 3 show the results.

It should be noted that the 3 refrigerators averaging higher than their DOE value had anti-sweat switches. The DOE test procedure turns these on 50% of the time. This may be a source of error since people rarely adjust their refrigerator after initial set up. Had the switches been 'on' constantly, higher than normal energy usage would result, exactly like these field results. The switches use about 200KWH per year³ which would move the refrigerators' energy use back between the DOE and Japanese values, similar to the other nine refrigerators. ETL Testing Laboratory of Cortland New York measured the DOE values used here.³

Since average yearly kitchen temperatures in this area are substantially below the 90 degrees F DOE tests at, less energy consumption is expected. The nine refrigerators without anti-sweat switches averaged 25% below the DOE estimate. This is between the 30% value predicted by Graig A. Spolek¹ for the Portland area and the 22% figure found by Heinemeier & Meier.² For the entire sample of 12, average annual consumption was found to be 16% less than DOE predicted.

Table 2 Energy Consumption Comparison

Site #	Brand	Energy Use (KWH/yr)					% Difference		
		JPN	Field	Std Dev	BPA	DOE	JPN	BPA	DOE
531	Sanyo	704	756	3	796	1049	7	-5	-28
532	Sanyo	704	678	10	751	1049	-4	-10	-35
533	Hitachi	986	1391	26	1337	1365	41	4	2
534	Hitachi	986	1425	60	1364	1365	45	4	4
535	National	792	885	9	708	1077	12	25	-18
536	National	792	729	5	698	1077	-8	4	-32
537	National	449	549	2	557	675	22	-1	-19
538	Mitsubishi	449	619	10	617	679	38	0	-9
539	Hitachi	1142	2031	11	1863	1799	78	9	13
540	Hitachi	292	413	4	373	537	41	11	-23
541	National	376	414	3	446	533	10	-7	-22
542	National	365	421	8	495	573	15	-15	-27
AVERAGE		670	859	13	834	982	25	2	-16

Note: Numbers in the BPA column represent a preliminary, non-rigorous analysis of energy use data on the 12 refrigerators tested.

Table 3 Duplicate Unit Energy Comparison

Brand	Model	Size Cu. Ft. (Liters)	Energy Use (KWH/yr)					
			DOE		Field		% Diff.	
			#534	#533	#534	#533	#534	#533
Hitachi	R-951SB	17.4(492)	1372	1357	1425	1391	4	3
National	NR455ER-W	16.0(453)	1106	1048	729	885	-34	-16
Sanyo	457FBA	19.6(555)	1040	1058	678	756	-35	-29

Peak Power

Tables 4 - 6 show peak power for all units. Peak power can be a little misleading on a weekly basis. For some peaks there are reasons; making ice molds for a wedding, repair of an ice maker, data taken on a date other than specified (One person confessed!), or having 25 people over for dinner. Monthly data tends to average out poor data taking and realistic events in a refrigerator's life.

Presenting all peak data in average daily numbers allows easy comparison between weekly, monthly, and yearly data. This also allows direct comparison between months of different lengths.

Peak weeks averaged 59% over average weeks while peak months averaged 25% over average months. Peak 52-week periods averaged 2% over average 52-week consumption. July and August were consistently peak power months. High correlation of energy consumption with ambient temperature leads one to expect highest energy consumption during the hottest months. In only one case (#534), October was highest by 1% over August.

It was interesting that many of the refrigerators exhibited an upward trend in energy use, though only of a couple percent. Further monitoring would be required to verify this or determine causes.

Some differences in annual peak figures could be related to occupants initially being self conscious about using a monitored refrigerator. Other factors could include changing of refrigerator adjustments, decreasing efficiency of compressor, etc.

Table 4 Weekly Peak Summary

Site #	Daily Average (Weekly)	Peak Daily Average (Weekly)	Percent Difference	Percent Difference From DOE	Percent Difference From JAPAN
531	2.09	2.86	37%	-0.3%	48%
532	1.91	3.86	102%	34%	100%
533	3.77	4.86	29%	30%	80%
534	3.93	6.86	75%	83%	154%
535	2.44	3.00	23%	1.7%	38%
536	2.07	3.00	45%	1.7%	38%
537	1.51	1.86	23%	0.5%	51%
538	1.68	2.43	45%	31%	98%
539	5.35	9.71	81%	97%	210%
540	1.16	2.00	72%	36%	150%
541	1.16	1.43	23%	-2.0%	39%
542	1.16	2.86	147%	82%	186%
AVERAGE			59%	33%	134%

Table 5 Monthly Peak Summary

Site #	Daily Average (Monthly)	Peak Daily Average (Monthly)	Percent Difference	Percent Difference From DOE	Percent Difference From JAPAN
531	2.10	2.55	26%	-7.7%	37%
532	1.89	2.85	51%	-0.7%	48%
533	3.76	4.44	18%	19%	64%
534	3.95	4.89	24%	31%	81%
535	2.44	2.83	16%	-4.1%	30%
536	2.03	2.36	16%	-20%	8.8%
537	1.51	1.77	17%	-4.3%	44%
538	1.68	2.10	25%	13%	71%
539	5.37	6.63	23%	34%	112%
540	1.17	1.45	24%	-1.4%	81%
541	1.16	1.37	18%	-6.2%	33%
542	1.16	1.62	40%	3.2%	62%
AVERAGE			25%	4.7%	56%

Table 6 Annual Peak Summary

Site #	Daily Average (Annual)	Peak Daily Average (Annual)	Percent Difference	Percent Difference From DOE	Percent Difference From JAPAN
531	2.08	2.08	0.3%	-28%	7.7%
532	1.86	1.92	3.1%	-33%	-0.7%
533	3.75	3.92	2.6%	4.5%	45%
534	3.91	4.13	5.5%	10%	52%
535	2.43	2.46	1.4%	-17%	13%
536	2.00	2.04	2.1%	-31%	-6.1%
537	1.51	1.52	0.5%	-18%	23%
538	1.70	1.74	2.4%	-6.6%	41%
539	5.58	5.61	0.5%	13%	79%
540	1.13	1.16	1.9%	-22%	44%
541	1.14	1.15	1.0%	-22%	11%
542	1.16	1.18	2.4%	-25%	18%
AVERAGE			2.0%	-15%	27%

Energy Consumption vs. Environmental Variables

Regressions of energy consumption vs. certain variables and outside temperature provided the results shown in Table 7. Regression of percent difference from the DOE value or the Japanese value were used against the kitchen's winter temperature and number of occupants. Using DOE as a reference allows normalization of the energy consumption between different refrigerators. Refrigerators having anti-sweat switches were not used in these two correlations because of their suspect relationship to the DOE value.

Values from February 1988 gave the low r-squared values shown in Table 7.

Table 7 Regression Results

Regression Variables	r ²	# of observ.	degrees freedom
Energy use vs. outside temp. vs. DOE	0.87	197	194
Aggreg. energy use vs. outside temp.	0.86	12	10
# People vs. % diff. from DOE (neg)	0.37	9	7
# People vs. % diff. from JPN (neg)	0.33	9	7
Energy use vs. door openings (avg)	0.10	~75	
Kit. temp vs. % diff from DOE	0.03	9	7
Kit. temp vs. % diff from JPN	0.05	9	7

Outside Temperature

Outside temperature had an r^2 of 0.86 when regressed with aggregate energy consumption. Outside temperatures were available from a building being monitored in Portland. Table 8 shows individual results for each refrigerator. Lower r^2 values could be due to household heating/cooling habits.

Equations in Table 8 allow prediction of daily energy use based on outside temperature.

Table 8 Daily Energy Use Relative to Outside Temperature

Site #	Brand	Constant in KWH	X Coef.	r^2	No. Observ.	Degrees Freedom
531	Sanyo	1.10	0.017	0.62	17	15
532	Sanyo	-0.40	0.041	0.88	18	16
533	Hitachi	2.02	0.031	0.62	16	14
534	Hitachi	2.78	0.020	0.19	17	15
535	National	1.66	0.013	0.64	17	15
536	National	0.95	0.018	0.78	15	13
537	National	1.17	0.005	0.40	17	15
538	Mitsubishi	1.02	0.012	0.43	17	15
539	Hitachi	3.21	0.037	0.33	17	15
540	Hitachi	0.84	0.005	0.20	16	14
541	National	0.51	0.011	0.88	16	14
542	National	0.61	0.009	0.29	14	12

Outside Temperature and DOE Predicted Value

Multivariate regression of average daily energy use per month with outside temperature and DOE predicted values gave the following equation. This equation allows energy use predictions of various refrigerators in different climates.

$$\text{Field KWH/day} = (.00323 * \text{DOE}) + (.0183 * \text{Out.Temp.}) - 1.900$$

$$r^2 = 0.87$$

of Observations = 197

Degrees of Freedom = 194

Out. Temp. is average daily outside temperature in degrees F.
DOE is DOE predicted value in KWH/yr

Occupants

Regression of occupants vs. percent difference from DOE or Japanese values resulted in r^2 of .37 and .33, respectively, with a negative correlation. This suggests less energy use with more occupants (or possibly more food load). No regression equation is suggested since the r^2 is low and number of samples are low. A more detailed study would be required to even verify the trend.

Door Openings

Energy use vs. door openings produced r^2 values under .35 and averaging 0.10. This agrees with Reinhart's correlation of 0.3.⁴ As shown in previous reports^{4,5}, this is due to the small amount of energy lost by cool air leaving the refrigerator compared to the larger amount of energy typically stored in food. Sufficient credible data gives a high confidence level in these numbers.

Kitchen Temperature

Household thermostat set points during winter months provided the 'kitchen temperature' value used in this study. This is only a very rough approximation to actual kitchen winter temperatures. Such variables as distance from the thermostat and kitchen heating from cooking are not taken into account.

A more detailed study of actual kitchen temperatures would most likely give more accurate equations and predictions. "Field Performance of an Energy Efficient Refrigerator over 29 Months" by Roy E. Reinhart⁴ showed a correlation of .95 with kitchen temperature, while Alissi, Ramadhyani & Schoenhals found r^2 values exceeding .99 in their study.⁵ Extremely low r^2 values of .03 and .05 compared to values exceeding .99 in other studies suggest an inaccurate measurement technique.

Matched Pair Analysis

The matched pairs shed little light on relationships between winter kitchen temperature, number of occupants and energy consumption. The results were quite contradictory. This included situations like a refrigerator using less energy in a 5 person, 68 degree situation than in a one person, 61 degree situation. The next pair would show just the opposite! See Table 9 below.

Table 9 Matched Pair Data

Site #	Number of Occupants	Thermostat Set Point	Field KWH/yr
531	1	61	756
532	5	68	678
533	1	70	1391
534	5	63	1425
535	1	66	885
536	6	61	729

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APPENDIX

AGGREGATE ENERGY USE AND OUTSIDE TEMPERATURE

AGGREGATE ENERGY USE AND OUTSIDE TEMPERATURE

FIELD DATA VS. DOE LAB RESULTS

$$\text{FIELD KWH/YR} = (1.2 * \text{DOE}) - 322$$

$$R_{sq} = .91$$

FIELD DATA VS. JAPAN LAB RESULTS

$$\text{FIELD KWH/YR} = (1.64 * \text{JAPAN}) - 238$$

$$R_{sq} = .85$$

ANNUAL ENERGY CONSUMPTION FOR 12 JAPANESE REFRIGERATORS

ANNUAL ENERGY CONSUMPTION FOR MATCHED PAIRS

WEEKLY ENERGY CONSUMPTION SANYO 457FBA (#531)

AVERAGE DAILY ENERGY CONSUMPTION SANYO 457FBA (#531)

WEEKLY ENERGY CONSUMPTION
SANYO 457FBA (#532)

AVERAGE DAILY ENERGY CONSUMPTION
SANYO 457FBA (#532)

WEEKLY ENERGY CONSUMPTION HITACHI R951SB (#533)

AVERAGE DAILY ENERGY CONSUMPTION HITACHI R951SB (#533)

The graph displays monthly energy consumption for two entities: DOE and JAPAN. The y-axis represents energy use in KWH per week, ranging from 0 to 60. The x-axis shows months from July 1977 to December 1978. The DOE series is a steady line at approximately 25 KWH/WK. The JAPAN series is highly volatile, with a major peak in August 1978 and a sharp dip in May 1978.

Month	DOE (KWH/WK)	JAPAN (KWH/WK)
7 77	25	24
8 77	25	27
9 77	25	15
10 77	25	24
11 77	25	27
12 77	25	28
1 78	25	26
2 78	25	24
3 78	25	27
4 78	25	28
5 78	25	21
6 78	25	25
7 78	25	29
8 78	25	26
9 78	25	31
10 78	25	27
11 78	25	30
12 78	25	26
1 79	25	28
2 79	25	24
3 79	25	27
4 79	25	28
5 79	25	21
6 79	25	25
7 79	25	29
8 79	25	26
9 79	25	31
10 79	25	27
11 79	25	30
12 79	25	26
1 80	25	28
2 80	25	24
3 80	25	27
4 80	25	28
5 80	25	21
6 80	25	25
7 80	25	29
8 80	25	26
9 80	25	31
10 80	25	27
11 80	25	30
12 80	25	26
1 81	25	28
2 81	25	24
3 81	25	27
4 81	25	28
5 81	25	21
6 81	25	25
7 81	25	29
8 81	25	26
9 81	25	31
10 81	25	27
11 81	25	30
12 81	25	26
1 82	25	28
2 82	25	24
3 82	25	27
4 82	25	28
5 82	25	21
6 82	25	25
7 82	25	29
8 82	25	26
9 82	25	31
10 82	25	27
11 82	25	30
12 82	25	26
1 83	25	28
2 83	25	24
3 83	25	27
4 83	25	28
5 83	25	21
6 83	25	25
7 83	25	29
8 83	25	26
9 83	25	31
10 83	25	27
11 83	25	30
12 83	25	26
1 84	25	28
2 84	25	24
3 84	25	27
4 84	25	28
5 84	25	21
6 84	25	25
7 84	25	29
8 84	25	26
9 84	25	31
10 84	25	27
11 84	25	30
12 84	25	26
1 85	25	28
2 85	25	24
3 85	25	27
4 85	25	28
5 85	25	21
6 85	25	25
7 85	25	29
8 85	25	26
9 85	25	31
10 85	25	27
11 85	25	30
12 85	25	26
1 86	25	28
2 86	25	24
3 86	25	27
4 86	25	28
5 86	25	21
6 86	25	25
7 86	25	29
8 86	25	26
9 86	25	31
10 86	25	27
11 86	25	30
12 86	25	26
1 87	25	28
2 87	25	24
3 87	25	27
4 87	25	28
5 87	25	21
6 87	25	25
7 87	25	29
8 87	25	26
9 87	25	31
10 87	25	27
11 87	25	30
12 87	25	26
1 88	25	28
2 88	25	24
3 88	25	27
4 88	25	28
5 88	25	21
6 88	25	25
7 88	25	29
8 88	25	26
9 88	25	31
10 88	25	27</

The graph displays two data series: DOE (represented by a line with open square markers) and JAPAN (represented by a line with solid square markers). The left Y-axis measures Average kWh/day (0 to 6), and the right Y-axis measures Temperature in Degrees F (35 to 80). The X-axis represents the Month (8 to 12). The DOE series shows a significant peak in kWh/day in month 7 (approx. 5.1) and a sharp decline in month 12 (approx. 1.3). The JAPAN series shows a more stable kWh/day profile, peaking in month 10 (approx. 4.8) and dipping in month 12 (approx. 3.5). Both series show a similar trend in temperature, peaking in month 7 (approx. 75°F for DOE, 72°F for JAPAN) and reaching a minimum in month 12 (approx. 45°F for DOE, 40°F for JAPAN).

Month	DOE (kWh/day)	JAPAN (kWh/day)	DOE Temp (°F)	JAPAN Temp (°F)
8	5.1	3.6	72	62
9	4.4	3.8	70	64
10	3.4	3.5	66	62
11	2.2	3.5	58	62
12	0.9	3.4	45	60
1	0.9	3.6	45	62
2	1.8	3.7	50	63
3	2.1	3.7	52	63
4	3.0	3.7	55	63
5	3.7	3.7	60	63
6	4.3	3.9	65	65
7	5.1	4.1	75	72
8	4.9	4.8	72	70
9	4.4	4.6	68	68
10	3.5	4.8	62	70
11	2.0	4.6	50	68
12	1.3	3.5	45	60

AVERAGE MONTHLY OUTSIDE TEMPERATURE

WEEKLY ENERGY CONSUMPTION NATIONAL NR455ER-W (#535)

AVERAGE DAILY ENERGY CONSUMPTION NATIONAL NR455ER-W (#535)

WEEKLY ENERGY CONSUMPTION NATIONAL NR455ER-W (#536)

AVERAGE DAILY ENERGY CONSUMPTION NATIONAL NR455ER-W (#536)

WEEKLY ENERGY CONSUMPTION NATIONAL NR434TR-W (#537)

AVERAGE DAILY ENERGY CONSUMPTION NATIONAL NR434TR-W (#537)

WEEKLY ENERGY CONSUMPTION MITSUBISHI MR4236W (#538)

AVERAGE DAILY ENERGY CONSUMPTION MITSUBISHI MR4236W (#538)

WEEKLY ENERGY CONSUMPTION HITACHI R-942SID (#539)

AVERAGE DAILY ENERGY CONSUMPTION HITACHI R-942SID (#539)

WEEKLY ENERGY CONSUMPTION HITACHI R-316KV (#540)

AVERAGE DAILY ENERGY CONSUMPTION HITACHI R-316KV (#540)

WEEKLY ENERGY CONSUMPTION NATIONAL NR346HV-W (#541)

AVERAGE DAILY ENERGY CONSUMPTION NATIONAL NR346HV-W (#541)

The graph displays monthly energy consumption for two entities, DOE and JAPAN, from July to September. The y-axis represents energy use in KWH/WK, ranging from 0 to 20. The x-axis shows months, with labels for 7, 8, and 9 repeated for each year. The DOE line starts at approximately 3.5 KWH/WK in July, peaks at nearly 20 KWH/WK in July, and then fluctuates between 5 and 11 KWH/WK through September. The JAPAN line starts at approximately 3.5 KWH/WK in July, remains relatively flat until August, and then shows a significant increase, peaking at about 14 KWH/WK in September.

Month	DOE (KWH/WK)	JAPAN (KWH/WK)
7	3.5	3.5
8	19.5	3.5
9	4.0	3.5
10	4.0	3.5
11	11.0	3.5
12	10.0	3.5
1	8.0	3.5
2	8.0	3.5
3	9.0	3.5
4	6.0	3.5
5	8.0	3.5
6	9.0	3.5
7	6.0	3.5
8	13.0	3.5
9	7.0	3.5
10	12.0	3.5
11	9.0	3.5
12	11.0	3.5
1	10.0	3.5
2	6.0	3.5
3	10.5	3.5
4	5.0	3.5
5	8.0	3.5
6	6.0	3.5
7	7.0	3.5
8	7.0	3.5
9	7.0	3.5
10	8.0	3.5
11	7.0	3.5
12	9.0	3.5
1	6.0	3.5
2	10.0	3.5
3	6.0	3.5
4	10.0	3.5
5	5.5	3.5
6	5.5	3.5
7	5.0	3.5
8	6.0	3.5
9	8.5	3.5
10	5.5	3.5
11	5.5	3.5
12	5.5	3.5
1	5.0	3.5
2	8.5	3.5
3	6.0	3.5
4	10.5	3.5
5	5.0	3.5
6	8.0	3.5
7	5.0	3.5
8	9.0	3.5
9	7.0	3.5
10	13.0	3.5
11	7.0	3.5
12	12.0	3.5
1	9.0	3.5
2	10.0	3.5
3	9.0	3.5
4	13.0	3.5
5	3.0	3.5
6	8.0	3.5
7	12.0	3.5
8	7.0	3.5
9	14.0	3.5
10	7.0	3.5
11	12.0	3.5
12	7.0	3.5
1	7.0	3.5
2	7.0	3.5
3	7.0	3.5
4	7.0	3.5
5	8.0	3.5
6	7.0	3.5
7	9.0	3.5
8	7.0	3.5
9	14.0	3.5
10	7.0	3.5
11	12.0	3.5
12	7.0	3.5
1	7.0	3.5
2	7.0	3.5
3	7.0	3.5
4	7.0	3.5
5	8.0	3.5
6	7.0	3.5
7	9.0	3.5
8	7.0	3.5
9	14.0	3.5
10	7.0	3.5
11	12.0	3.5
12	7.0	3.5
1	7.0	3.5
2	7.0	3.5
3	7.0	3.5
4	7.0	3.5
5	8.0	3.5
6	7.0	3.5
7	9.0	3.5
8	7.0	3.5
9	14.0	3.5
10	7.0	3.5
11	12.0	3.5
12	7.0	3.5
1	7.0	3.5
2	7.0	3.5
3	7.0	3.5
4	7.0	3.5
5	8.0	3.5
6	7.0	3.5
7	9.0	3.5
8	7.0	3.5
9	14.0	3.5
10	7.0	3.5
11	12.0	3.5
12	7.0	3.5
1	7.0	3.5
2	7.0	3.5
3	7.0	3.5
4	7.0	3.5

- END -

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