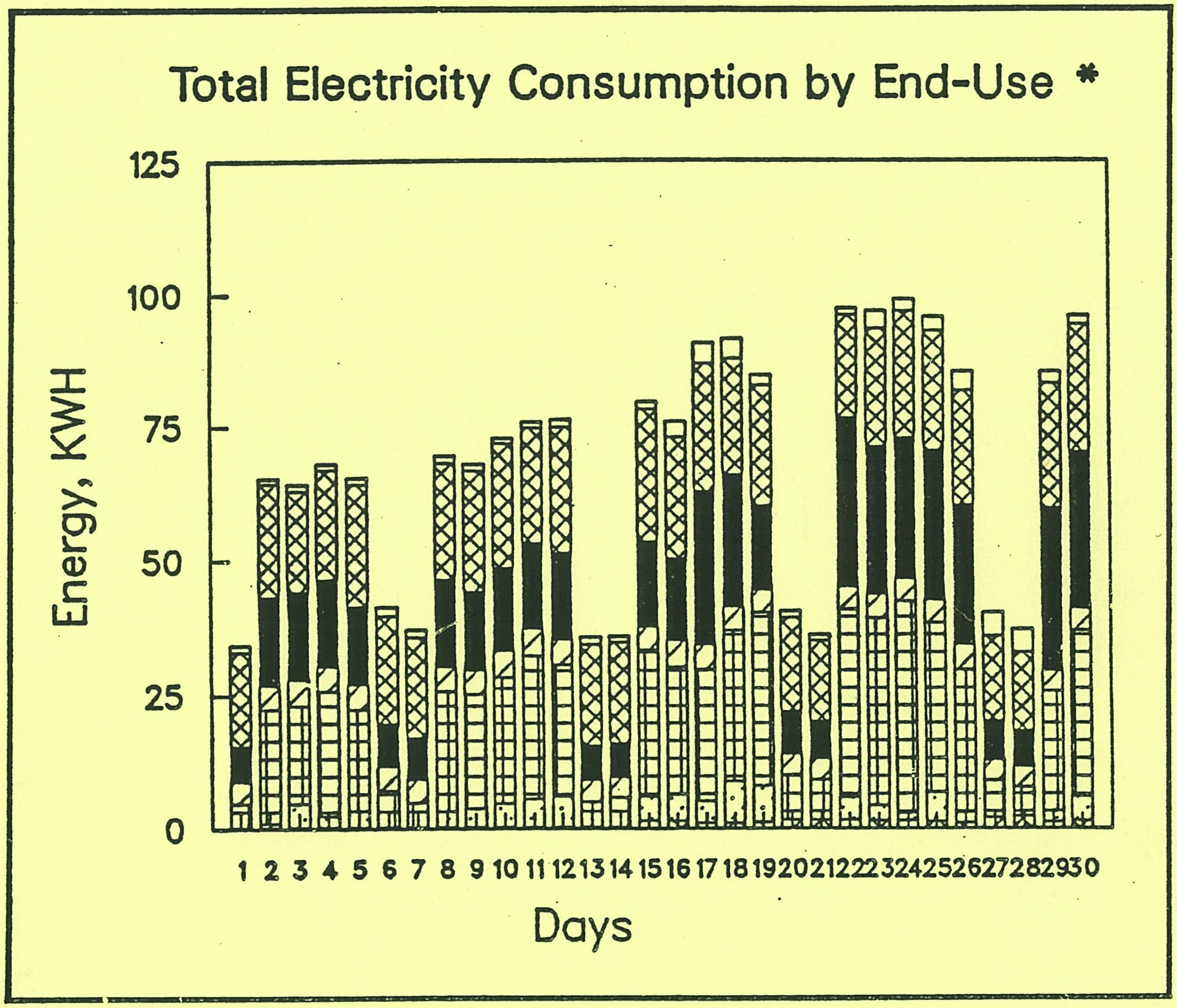
ELCAP COMMERCIAL BUILDINGS REVISITED

Second Edition



Adele Martz
Energy Management Services
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May 1990

ELCAP Commercial Buildings Revisited
Second Edition

A Report on the Electric End Uses in Seventy-five Commercial ELCAP Buildings in the Seattle, Washington, Area.

Adele Martz

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June 1990

With the assistance of:

Annet Ditmer, Pacific Northwest Laboratories, Richland, Washington, who extracted the graphs from the data.

Colleen Cleary, Seattle City Light, who encouraged and critiqued the report.

Frances Duffy and Ellen Javines, Seattle City Light, who typed and helped put it all together.

The building owners and tenants, who were helpful and cooperative and without whom the study would not have been possible.

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I. OVERVIEW

ELCAP

The End-Use Load Conservation Assessment Project (ELCAP) is a multiyear research effort sponsored by the Bonneville Power Administration to better understand the energy requirements and conservation potential of electrical loads in the Pacific Northwest region. The study is being conducted by Battelle Institute-Pacific Northwest Laboratory (PNL) in Richland, Washington. It is designed to measure and analyze hourly end use of energy in commercial buildings and in homes in the BPA region. There are twelve separate projects: seven residential sector projects, two multifamily, two retrofit building projects and finally the commercial sector. This report addresses only the commercial sector of ELCAP. (See ELCAP Workshop Abstracts, November 1985, for more detail). [1]

Battelle Institute-Pacific Northwest Laboratory (PNL)

Battelle of Columbus, Ohio, is a large private research company whose founder's purpose was the betterment of mankind. The Pacific Northwest Laboratory (PNL) branch is located in Richland, Washington. The Human Affairs Research Center (HARC) is located in Seattle. PNL set up operations at HARC for the selection, recruitment and installation of the Field Data Acquisition System (FDAS) in the commercial buildings in the Seattle area. When about half of the buildings had the loggers (FDAS) installed, BPA, in its own budget crunch in mid-1986, cut some of the funding for ELCAP.

Seattle City Light

With the closing of the Seattle ELCAP office, BPA requested Seattle City Light's (SCL) support in maintaining local site relations with the building owners participating in the study. By assuming this responsibility SCL would help to sustain a research project of regional importance and assure itself of access to ELCAP data useful for SCL's conservation, consumer research and load forecasting analyses. Without SCL's support, monitoring of some commercial sites would be terminated early when local verification of building changes or problems could not be made. With SCL's contribution of staff time, the participation rate should not decline, thus increasing the value of the data to SCL and regional applications. Seattle City Light and BPA have cooperated on a number of regional energy studies in the past few years and this is an example where this spirit of mutual cooperation benefits both agencies well.

II. PROJECT HISTORY

Commercial Building Selection

A group of 200 commercial buildings in the Seattle area were randomly selected. Owners and tenants were recruited to participate. The final selection of 84 was not entirely random. Some factors were:

- o Owner and tenant cooperation and signed access agreement were required.
- o Condition of the wiring needed to meet code.
- o Identification of end uses had to be reasonably possible.

For detailed information, see "ELCAP, Commercial Sector Sample Design," BPA, April 1986. [2]

If these criteria could not be met, the building was dropped from the sample. Due to funding cuts, only 84 buildings had loggers (FDAS) installed and are delivering data. During the subsequent 3 years several buildings had the loggers removed for various reasons. Demolition, complete gutting and rebuilding which extended over a long period of time, owner or tenant refusing to have the monitor in their building, long periods of vacancy, difficulty in separating the loads or, decision by PNL to discontinue because they felt the information being gathered was not useful. Thus the sample was further diminished. There are also 57 recruited buildings "on hold" which would have been included in the project if funds permitted.

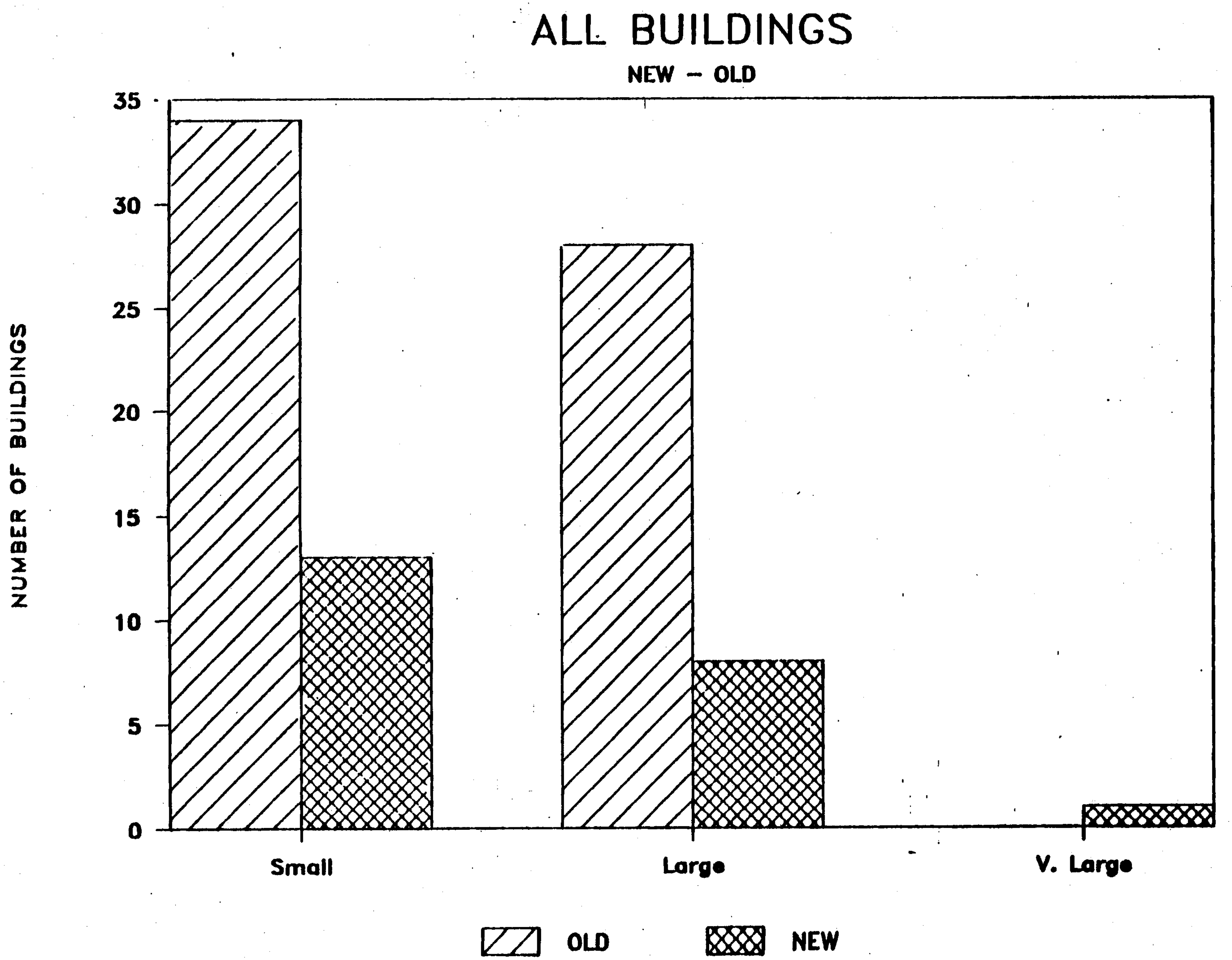
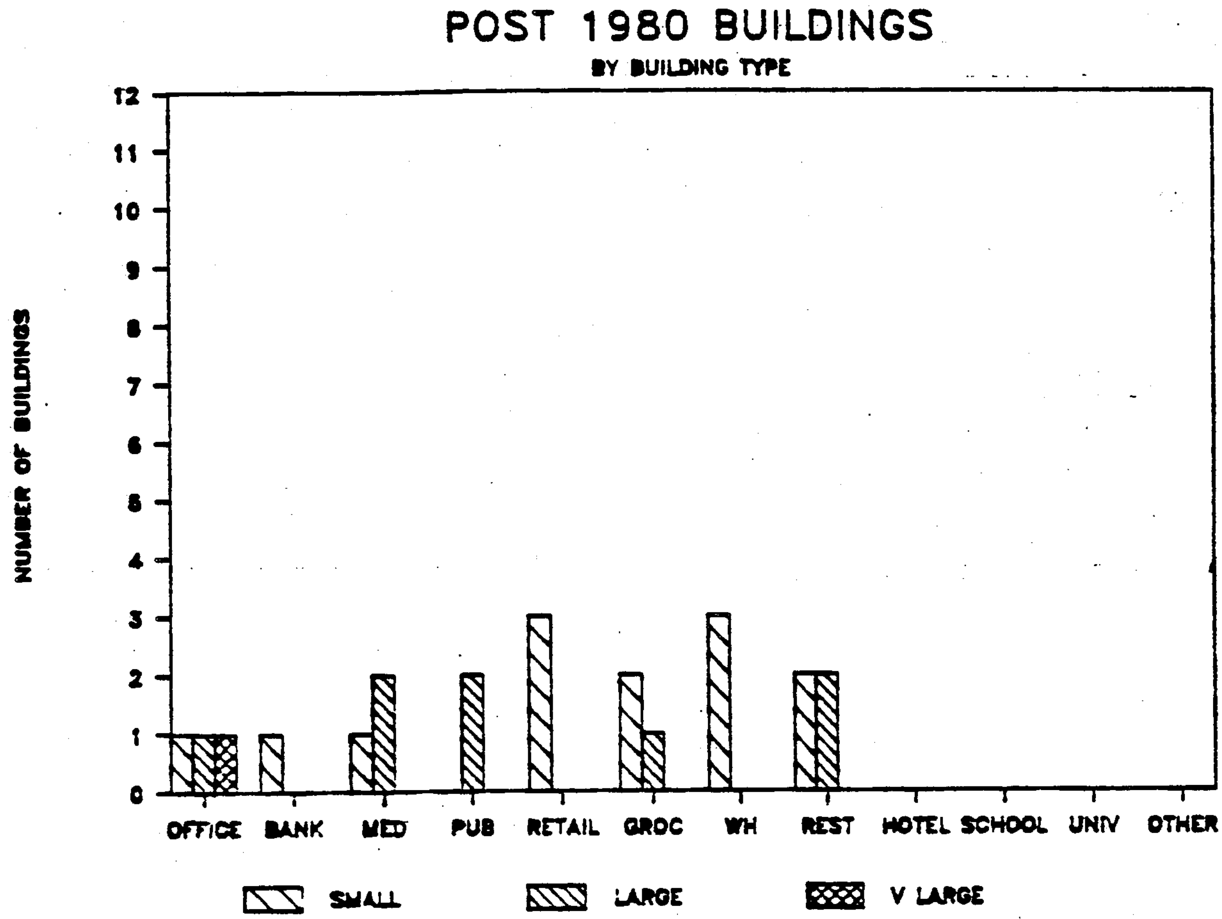

ALL BUILDINGS
NEW – OLD
NUMBER OF BUILDINGS
35
30
25
20
15
10
5
0
Small
Large
V. Large
OLD
NEW

Figure I


POST 1980 BUILDINGS
BY BUILDING TYPE
NUMBER OF BUILDINGS
0
1
2
3
4
5
6
7
8
9
10
11
12
OFFICE
BANK
MED
PUB
RETAIL
GROC
WH
REST
HOTEL
SCHOOL
UNIV
OTHER
SMALL
LARGE
V LARGE

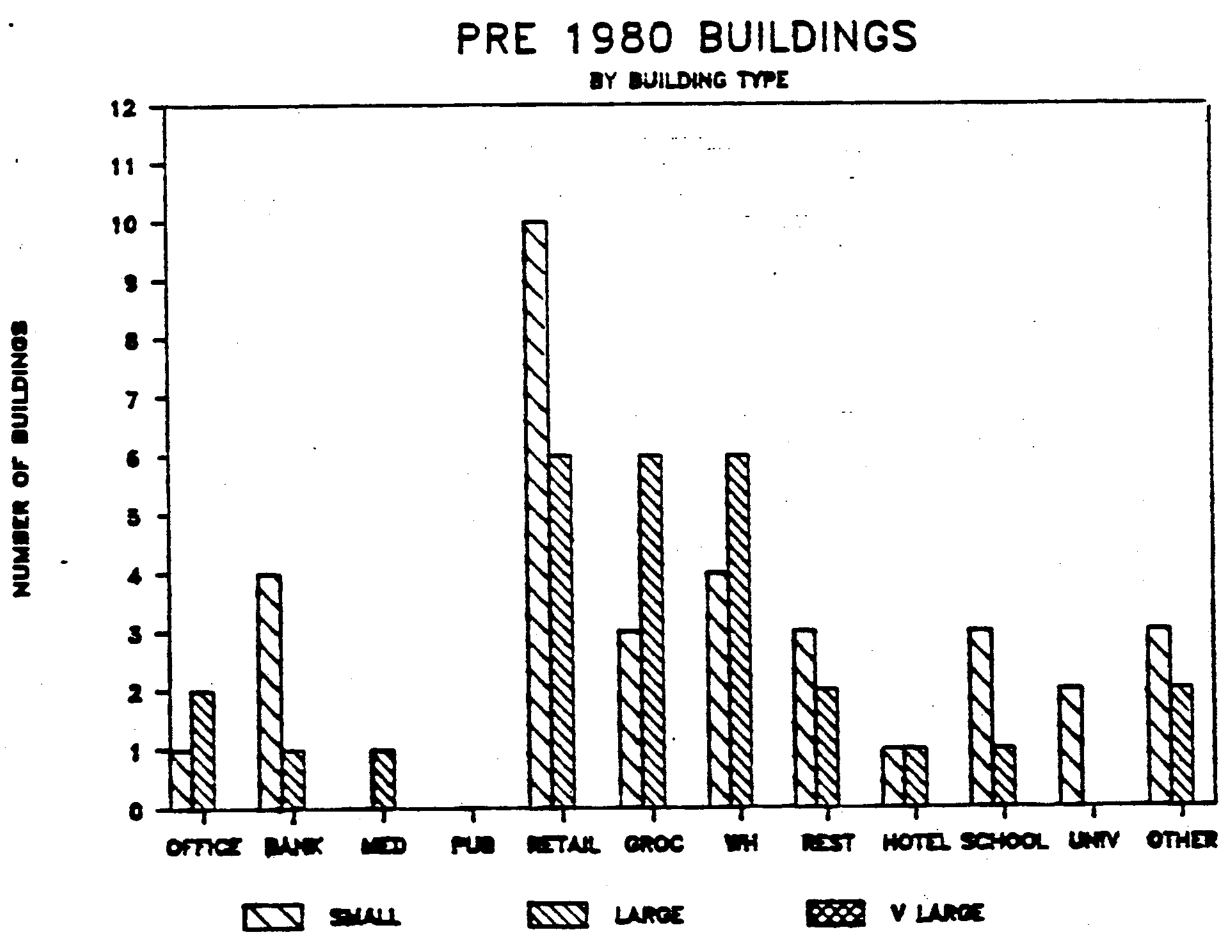

PRE 1980 BUILDINGS
BY BUILDING TYPE
NUMBER OF BUILDINGS
0
1
2
3
4
5
6
7
8
9
10
11
12
OFFICE
BANK
MED
PUB
RETAIL
GROC
WH
REST
HOTEL
SCHOOL
UNIV
OTHER
SMALL
LARGE
V LARGE

Figure II

REFERENCES

1 "ELCAP Workshop Abstracts," Deleata J. Alexander et al, Pacific Northwest laboratories, for Bonneville power Administration, November 1985.

2 "ELCAP Commercial Sector Sample Design," Michael Baker, Pacific Northwest Laboratories, for Bonneville Power Administration, April 1984.

3 "ELCAP Survey Handbook," Pacific Northwest Laboratories and United Industries, for Bonneville Power Administration, April 1986.

Buildings were classified by age, those built before the 1980 energy building code was in effect and those built after 1980. Of the 84 sites, 30 percent are buildings built after 1980 and 70 percent were built before 1980. major types included were diverse office buildings (21 percent), dry goods and retail stores (23 percent), restaurants (11 percent), schools and universities (7 percent), warehouses (15 percent), and others (6 percent). The sample includes 47 small buildings (up to 50,000 square feet), 36 large buildings (up to 99,990 square feet), and one very large building over 100,000 square feet and six stories tall. (See Figures I and II).

Monitoring Procedures

The Field Data Acquisition System (FDAS) is a microcomputer based data logger. One or more loggers are installed in each building. A current transformer (CT) is placed around the wire from the circuit breaker to each piece of equipment or each use such as lighting. The CT's are connected to a particular slot in the logger. The electric pulses on each channel are recorded by the logger computer. Each channel is identified and coded by end use. The loggers are connected by telephone to PNL in Richland, Washington. Each logger is called regularly for a reading. Data can be collected for 15-minute or for hourly readings. The information is then entered into the main computer in Richland. Data is verified for reasonableness.

A tremendous amount of work is done to be sure all channels are working and delivering good data and to assure the telephone lines are working. PNL has a special team to maintain the loggers. These procedures are used for the 84 commercial sites and for several hundred residences and other buildings scattered over the entire BPA region.

An audit or survey was conducted on each building, encoded and entered into the PNL computer. The survey includes building characteristics: square footage, all energy systems, equipment installed, hours of operation, number of people each hour, etc. The "measurement plan" documents the power supply, which circuits are monitored by which channels, and the end use of each one (see ELCAP Survey Handbook). [3]

These documents and data must be kept current as changes occur, such as remodeling of building, lighting or equipment added, deleted or moved, modification of electrical service, changing times or levels of operation. If the owner or tenant changes, the new owner or tenant must be "recruited" and sign an access agreement so PNL can continue monitoring the data from the building.

III. THE REVISIT

The purpose of the 1987-89 site visit by the SCL Site Relations Representative was to update and revise the original survey conducted by Battelle in 1985-86. Additional information was gathered. The revisits provided an opportunity to gather information not found in the original survey. West facing buildings often have no natural or constructed shading, or controlled window covering. Asphalt parking lots next to an expanse of glass is common in buildings such as grocery stores or office buildings. This contributes a great amount of radiant heat to them. Seattle is a city built for the most part on a north-south grid to take advantage of views of the mountain ranges, Puget Sound and Lake Washington. Thus many buildings face east or west, not the best angles for winter solar gains, but afford devastating solar gains in the summer when it is daylight until 9:30 p.m. The placement of trees or other large buildings would make a dramatic difference to the energy use in some buildings. At each revisit these conditions were noted if they were significant to the energy use in the building.

If buildings and their occupants were standard and never changed it would be easier to evaluate their energy use and the potential for conservation. But nothing is static.

The original survey was done two or more years before the revisits in 1987-89. In many buildings new equipment has been installed; a freezer in place of a copy machine, or equipment has been eliminated; a toaster oven replaced by a microwave oven, etc. In that time there have also been some structural changes in some buildings. Some additions have been built, storage areas have been converted to work areas, interior walls have been constructed. Some new businesses may have moved in and made major or minor changes in equipment. The new businesses tended to be similar to the old, but the hours of operation or the number of occupants may have changed. The behavior of the occupants in regard to energy use may also be different from the original occupants. These changes impact the patterns and amount of consumption.

Table I gives an overview of the changes up to May 1, 1988, that were documented at the revisit. Subsequent changes through July 1989 are also listed.

There were several changes in the buildings. Some influenced energy use, others did not. All structural changes and about half of the equipment changes will probably affect the energy consumption patterns in those buildings in which the changes occurred. Tenant changes seemed to have the least impact with only 16 percent of them affecting the energy use. In any specific space a new tenant tended to be similar to and function like the old tenant.

TABLE 1

Bldg. Type	No.	Visited	Dropped	CHANGES UP TO MAY 1, 1988 Tenant	Equipment	Structure
DGR	19	18	2	4	4***	1*
GRO	12	10	0	2	3**	1*
HTM	2	1	1	0	1*	0
OFP	6	5	0	1	0	0
OFF	1	1	0	1	0	0
OFG	6	4	0	2	3**	2**
OFM	4	4	0	3	2	1*
OFP	2	2	0	0	1	1*
OTH	4	4	1	0	0	0
RES	9	9	0	2*	3***	2**
SCH	4	3	1	0	1	0
UNI	2	1	0	0	0	0
WAR	13	10	0	4**	4***	2**
TOTAL	84	72	5	19	23	10

* Each asterisk indicates a major change which should impact the total consumption and/or the patterns of consumption in that building. These major changes are:

DGR002, added more display lights and several video terminals. February 1988

DGR012, has new tenants in formerly unused space, new electric equipment. also, extensive building modifications. November 1987 - May 1988.

DGR108, the new tenant replaced main ceiling lighting fixtures, added several display lights. May 1987

GRO107, refrigeration system removed. All equipment removed in process of becoming a bingo parlor. March 1988

GRO108, lighting system changed, equipment added. May 1987

GRO401 will undergo a major remodel in fall of 1988, new deli service and change in lights. August 1988 - October 1988.

HTM has replaced room air conditioners with new, smaller capacity air conditioners. December 1987 - ongoing.

OFG102, new tenants, interior spaces changed which will impact HVAC system. November 1987

OFG401, new tenants, one third of previous operating hours, major equipment removed, interior remodel. April 1988 - ongoing.

OFM301, former open parking space under the building enclosed for new office space. September 1987

OFP402, an interior wall added to separate conditioned from unconditioned area. January 1987

RES005, complete renovation, new systems, equipment and space. March 1988

RES302, new tenant, different kind of business, major refrigeration equipment removed October 1986. Then another change--vacant since May 1988.

RES401, new tenant, different style restaurant, modified exhaust system, enlarged space. September 1986

WAR004, new tenant, more employees, now a workshop with new electric equipment and lights. Interior walls reconstructed. April 1988

WAR005 building an addition which will be open to the present warehouse, will almost double the warehouse space.

WAR106, one large major tenant has been replaced by four smaller ones. heavily used electric processing equipment moved out, small load equipment now installed. November 1987 - May 1988.

WAR301 was a greenhouse with large lighting load. Building vacant since April 1988.

WAR303, a large commercial refrigeration facility has been installed inside the warehouse. February 1988.

Changes from May 1, 1988 to May 1, 1989.

DGR002 moved some of its operation to another building. In the sales area it added nine TV display units and more spot lights.

DGR003 was no longer in the study.

DGR010 constructed a wall between the shop and the retail space.

DGR012 completed their remodel.

DGR103 went through the Conservation Incentive Pilot Program with SCL in 1987.

GRO103 and GRO104 will also go through the CIPP program the end of 1989 or beginning of 1990.

OFB103 put bronze film on the office windows.

OFG001 Will be remodeled early 1990.

OFG101 Moved interior walls, added small amount of interior lights.

OFG501 Continues to have constant turn over. Because it is a large building with many tenants the impact of each move is not great. The tenants still tend to be financial or insurance companies.

OTH104 Underwent a complete renovation of all systems as well as building components. However, since it was closed for a year to do this, it was removed from the study.

RES001 Interior incandescent lights changed to compact fluorescents. Entire chain across the country is doing this in 1989.

RES002 1989 under new ownership. No major changes in systems but the restaurant now has bulbs in all the fixtures. The lighter furniture & carpet colors make it appear much brighter.

RES302 At the end of 1989 was still vacant.

RES402 Participated in the CRUES program, 1989. Had a new energy management system installed.

WAR106 Had several tenant changes. Almost a revolving door for all but one, out of eight spaces.

WAR302 Converted a small unfinished space into office space.

In addition to the above changes, two of the buildings will be retrofit through BPA's Commercial Retrofit End Use Study--DGR108 and RES402. Others will be retrofit through Seattle City Light's Commercial Incentive Pilot Program--DGR103, GRO103, GRO104 and OFM402. There is a possibility others will also be retrofit.

In addition to updating and enhancing the original site survey information, the revisits had several other side benefits. First it was an opportunity to meet new owners and managers. In the new businesses, the owners were generally unaware of the ELCAP monitoring operations. It is possible for the new tenants or owners to not notice the logger box. The revisit was an opportunity to explain the project and to gain their cooperation in the study. Most were very interested and readily agreed to continue monitoring. Some were even more enthusiastic about the project than the original owners. Only one new tenant absolutely refused. He felt ELCAP was using his electricity. Even offering him a stipend did not work.

In the restaurant business every revisit was an opportunity to meet the new manager--it seems there is always a new manager in each of the chain restaurants. This turnover can influence the energy use of the building. The privately owned and operated restaurants are more likely to be run by the same owner for several years. Dry goods-retail and grocery stores have some changes. In this competitive market we see changes in lighting and in refrigeration. Office buildings, schools, warehouses and "other" tend to have fewer changes in personnel and in equipment, thus should have more consistent patterns of energy use.

In April 1989 the author of this report was reassigned to another full time position at Seattle City Light. Because of time restraints there are missing write ups for some of the buildings still in the study.

GRO103 and GRO105, same chain of stores as GRO101 and GRO104.
OFB004, a small neighborhood bank.
WAR003 and WAR105, mixed use warehouses.

IV. UNUSUAL INFLUENCES

In November 1985 and February 1989 the Pacific Northwest experienced unusually cold weather, several days of below freezing weather and snow which did not melt. September 2, 1988 was the hottest day ever recorded in Seattle, 98°F. Again in September 1989 there were ten days of over 80°F day time temperatures. In temperature sensitive buildings these abnormalities should show up on the graphs. When snow sticks to the streets in Seattle businesses tend to open late and close early. Schools are closed.

The teachers' strike in 1985 delayed the opening of the public schools for a month. But they remained open through the middle of July in 1986. In the summer of 1989 a grocery clerk and meat cutters strike had an effect on the grocery stores. Those on strike GRO101, GRO103, GRO104 and GRO105 were normally open 24 hours a day. During the strike they changed their hours to 7 am to 11 pm. GRO401, one of the few major chains not on strike, had a tremendous increase in business and continued to remain open 24 hours a day.

In the summer of 1989 banks started to extend their hours of service and some even stayed open on Saturdays. Some of the larger supermarkets are also installing branch banks. These changes will impact the patterns and amounts of energy used.

V. OPPORTUNITIES FOR CONSERVATION

In commercial buildings the opportunities for conservation are in lighting measures, operations and maintenance, balancing and/or modifying the HVAC system and in heat recovery systems. Energy demands in commercial buildings are different than in residential buildings in which the major demands are heating and domestic hot water. Offices, schools and some retail stores operate only during the day and maybe early evening hours. They have high lighting levels and high occupancy rates, both of which contribute to internal heat gains. Therefore, even in cool weather there is a need for venting and air conditioning during occupied hours. Heat is needed for morning warm-up in the winter and little is needed during closed hours.

Grocery stores and restaurants have additional energy concerns. Grocery stores have large refrigeration and lighting loads. They are often open 24 hours a day with their refrigeration, lighting and exhaust systems on all the time. Restaurants and some grocery stores have refrigeration and food processing/cooking loads, which require heat exhaust and cooling.

Non-refrigerated warehouses are traditionally low energy users as they are keep just above freezing to prevent damage to the goods. There is usually no cooling other then natural ventilation when the doors are opened. Lighting levels are moderately high during working hours as the workers must be able to find things.

Lighting

Lighting is the major energy user in many commercial buildings. It also contributes heat, not usually a desirable side effect as air conditioning can be a large energy use in these buildings. With the present rapid development of efficient lighting systems there are constantly new opportunities to achieve dramatic savings by installing efficient lamps, fixtures and controls. More sophisticated controls, motion sensors, photo cells to control the perimeter lights inside a building, individual light controls for different areas, new reflectors for fixtures and other innovations offer many choices. New sizes and shapes of fluorescent tubes, a wide range of color rendition and aesthetically pleasing fixtures can meet even sophisticated decorator lighting needs. Remote lighting and daylighting techniques such as holograms, fiber optics and light pipes are gaining more attention. A deterrent to immediate change might be that a better, less expensive project may be on the market tomorrow. But the savings from the lighting

measures are usually great. Simple pay back is easy to calculate and may be only 2-3 years. Longer life, less maintenance and lower cooling load are also benefits.

Operations and Maintenance

Proper use of buildings and systems mean more efficient operations. Doors propped open give the wrong signal to the HVAC system. A thermostat installed above a lamp or other heat source or where the afternoon sun shines on it will cause the air conditioner to come on instead of the heat. Poor fitting door sweeps, windows left open, insulation moved, time clocks not adjusted, forgetful people not turning off the systems when not in use, all contribute to wasted energy.

Another opportunity for cutting energy consumption is in maintenance of HVAC, lighting and refrigeration systems, usually very low or no cost activities which pay off handsomely; such as cleaning or changing filters, dampers, cleaning light bulbs and reflectors.

Large buildings may have their own building engineer who takes care of running the systems and each of these people may take a different approach. For one, tenants' comfort may be the primary goal, without much attention to efficiency. The systems may be oversized but the tenants never complain because their individual needs for heating or cooling are always met. Another building engineer may be much more attentive to the efficient operation of the system or be more knowledgeable about the operation.

Buildings managed by large corporations may have regular service contracts for routine maintenance. These may cover only the bare minimum requirements. It is not unusual to have equipment installed and put into operation based on certain broad parameters, never to be adjusted again.

Individual owners or tenants in independently run buildings may have total responsibility for the operation and maintenance of the building and its systems. Their approach to energy use varies as much as that of individual home owners. Some are very conscientious about keeping filters clean, equipment in good repair and controls such as time clocks properly set. Others have little concept or concern about such things. If they don't understand the time clock for the exterior lights they may dismantle it and then depend on human memory to control the lights. When a repair man moves the ceiling tiles and the insulation over to gain access to equipment in the ceiling, but doesn't move it back in place, a huge gaping hole in the ceiling will probably remain. The teenagers who work there are not motivated to go to the trouble of correcting it. Another owner may be very concerned about a 60w bulb being left on in the locker room, but have no idea about how much energy is used by the 30 or so 150w spot lights in the outdoor soffit.

Automatic door openers, and closers, automatic thermostats, "smart" thermostats for heat pumps and automatic timers will reduce dependence on the humans who tend to be forgetful.

HVAC System

In the Pacific Northwest there are only a few times a year when the temperature and humidity are higher than the desired indoor temperature and humidity. Therefore outside air can be used for a large portion of the cooling needs. The temperature is always cool at night and outdoor air can be used to flush out excess heat build-up. However, many systems are set to automatically use the air conditioner. Resetting the HVAC system to use more outdoor air can be a great savings measure. In the Seattle area the relative humidity is low in summer and high in winter, a very desirable situation in using outdoor air to cool in summer and heat in winter. Most systems are not regulated by enthalpy but because of the natural conditions could be set to use air at higher outdoor temperatures in summer and cooler outdoor temperatures in the winter.

A commonly overlooked opportunity for savings is balancing the HVAC system. Many HVAC systems have been built and installed oversize, the "safety factor," so the system will always be assured of being able to meet the demands put on it--no matter how poorly controlled or maintained. Most systems could be balanced, at a relatively small cost, to operate more efficiently and would continue to meet the demands of the occupants.

Heat Recovery

Many commercial buildings generate great amounts of heat which must be exhausted or dissipated to prevent unbearable temperature rises inside the buildings. Refrigeration condensers in grocery stores and restaurants offer opportunities to capture this "clean" heat for either space heat or to preheat the domestic hot water. Heat recovery systems and heat pumps are designed to do this rather than throwing away the heat as is so often done by just venting it to the outside.

Restaurant kitchens have excessive heat. Heat pump water heaters can use this heat for the water and in turn furnish part of the air conditioning needed in the building.

Heat exchange systems can recover heat from exhaust air and, when needed, return the heat to the building's intake system. When the ventilation systems handle large cfm's the heat loss in cold weather can be large.

Hot Water

Most commercial buildings, other than food serving establishments or laundries have minimal need for hot water. People turn on the hot water faucet but do not wait for the water to run hot. This means hot water is drawn from the tank into the pipes where it then cools off, to be delivered as cold water the next time someone turns on the hot water faucet. Almost all the energy for hot water goes to standby losses. The tanks installed are usually large commercial tanks or 25-80 gallon residential tanks. Small 6 gallon tanks at point of use or instantaneous water heaters would greatly reduce the energy used to heat water and would have the added advantage of actually delivering hot water at the faucet. Where high temperature is not required the temperature should be reduced to 110°F as a very basic, easy measure.

Building Shell

Only in the last few years has much attention been given to the thermal properties of commercial buildings. In the old buildings there is no insulation in the walls, ceiling or floor. Windows are single pane.

The Seattle Building Code of 1980 required new commercial buildings to have R4 walls, R20 ceiling and R4.25 slab on grade floor. The 1986 code required R19 walls, R30 ceilings and R10 slab on grade floor. In both code revisions windows were to be double pane. Installed lighting was to be no more than 2w/sq.ft.

There are provisions for trade offs such as: 20 percent lower R value in the ceiling if the insulation is continuous instead of placed between joists (Building OFP402). or allowing less insulation in one part of a wall if it all averages out to R4 (Building OFP401). Spaces designed as warehouses are exempt from the building code insulation requirements.

In some of the ELCAP buildings there are opportunities to improve the thermal values and save some energy. In buildings with high internal gains and which are only used during the day the cost of most of these measures would not be justified by the savings. Simple, inexpensive measures such as weather stripping, caulking and repair of broken windows are cost-effective in most buildings. In some cases where cooling load is high, even in cool weather, shell measures can be counter productive. If insulation can be blown in the ceiling it is not very expensive and will make the building more comfortable in both winter and summer, if there is a need to retain heat in the winter. Deciduous trees planted in strategic spots, window shades or window films would help control insolation.

VI. END USE DATA GRAPHS

Computer generated graphs are being produced from the end use data collected from the Field Data Acquisition System (FDAS). These graphs can give an immediate picture of the electric consumption in the building. Other fuels are not included in these computations. If a building uses gas, wood or oil, these loads will not show on these graphs. We hope to have total amounts of other fuels used but they will not be by hourly end use.

For some buildings there are several graphs. At the time of this report data was available for about 50% of the buildings. Graph #1 is a pie chart giving the percent share of total electricity consumption by end-use. Graph #2 is a stacked bar graph showing total electricity consumption by end-use for each day of the reporting period.

Graph #3 is a line graph with the average daily electricity end-use profile by the time of day for the reporting period. Graph #4 is a line graph with the average daily total electricity use by time of day for the reporting period. Graph #5 is a bar graph showing total consumption by end use for the reporting period.

Graph #6 (if included) shows the percentage of reliable data. If it is not included, the data is assumed to be 100 percent reliable.

The 3D graphs can be made for individual end uses or for total electricity consumption (RES401, WAR303). They are most interesting as they can tell you the consumption for each hour of each day for individual end uses. Spikes which would effect averages over a period of time show up on these graphs. If one or two spikes appear in off hours, it may be because the painters and carpenters were working then and had everything turned on. The average profiles graph would make it appear that there is some activity at this time throughout the reporting period, rather than the one time intense use.

The 3D graphs can also show which days and at what times both the heat and the air conditioner were on or what particular time the lights were left on. It can explain some of the erratic end uses observed in the daily loads. For instance, the outdoor lighting should gradually decrease as spring advances. When we see it changing back and forth day to day on the daily bar graph (graph #2), we don't know what is happening. A 3D graph would show us if the lights were left on all day on a particular day, or if someone doesn't turn them on at night or what combination of activity creates this erratic picture on graph #2.

A few ELCAP buildings have been simulated on standard programs such as DOE2. In those buildings input assumptions about energy use varies from the ELCAP data both in time of day and in total amount of end use consumption. As more ELCAP data is acquired better assumptions will become possible and input data refined.

With permission from Battelle, the Commercial Section at SCL has used the connected load information from the surveys to better model the buildings participating in the CIPP. No end use data was available for these buildings at the time. However, it is hoped that before and after end use will eventually be available for these buildings.

IX. UTILITY RATES

In May 1989 commercial electric rate for Seattle City Light averaged \$.0258 per Kwh and for Puget Sound Power and Light it was \$.0503 per Kwh. The cost effectiveness of measures is therefore much greater for buildings located in the Puget Sound Power and Light service area than in Seattle City Light service area.

The detailed tables for before and after May 1, 1989, show how average Kwh costs are computed by Seattle City Light.

<u>Index of Building Profiles</u>

DGR001	GRO401	OTH104
DGR002	HTM101	RES001
DGR004	OFB001	RES002
DGR007	OFB002	RES005
DGR008	OFB003	RES103
DGR009	OFB004	RES302
DGR010	OFB103	RES303
DGR011	OFB301	RES401
DGR012	OFF301	RES402
DGR102	OFG001	SCH003
DGR103	OFG101	SCH004
DGR105	OFG102	SCH101
DGR106	OFG301	UNI001
DGR108	OFG401	UNI004
DGR110	OFG501	WAR002
DGR301	OFM103	WAR003
DGR302	OFM301	WAR005
DGR305	OFM401	WAR102
GRO002	OFM402	WAR103
GRO003	OFP401	WAR105
GRO004	OFP402	WAR106
GRO101	OTH001	WAR110
GRO104	OTH002	WAR301
GRO301	OTH003	WAR302
GRO302	OTH103	WAR303

ELECTRIC RATES
Commercial and Industrial Customer Classes

	Schedule 31 Small General Service No demand meters or less than 50kW Demand	Schedule 34 Medium General Service 50 - 1000 kW Demand (Former Schedule 46)	Schedule 35 Medium General Service 50 - 1000 kW Demand (Former Schedule 61)	Schedule 38 Large General Service 1000 kW or over Demand (Former Schedule 46)	Schedule 39 Large General Service 1000 kW or over Demand (Former Schedule 61)
Energy Charge All energy: Summer	2.56¢/kWh	2.11¢/kWh	1.81¢/kWh	2.18¢/kWh	1.87¢/kWh
Winter	4.21¢/kWh	3.52¢/kWh	2.97¢/kWh	Peak: 4.09¢/kWh Off-peak: 2.18¢/kWh	Peak: 3.78¢/kWh Off-peak: 1.87¢/kWh
Minimum Monthly Charge Per Meter	$4.40	$18.00	$18.00	$55.00	$55.00
Demand Charges All kW of Maximum Demand: Summer		$ 1.05/kW	$ 1.05/kW	$ .93/kW	$ .93/kW
Winter		$ 2.31/kW	$ 2.31/kW	$ 2.04/kW	$ 2.04/kW

Summer rates apply April - November. Until May 1, 1989
Winter rates apply December - March.

Discounts:
- Transformer investment: 10¢/kW/month
- Transformer losses: 1% of monthly maximum demand times 730 hours
- Interruptibility: $1.64/kW/month in 4 winter months plus $1.85/kW/month if interrupted

Demand and peak energy charges for Schedule 38 and 39 customers are assessed during the peak rate period only; 7 a.m. to 10 p.m., Monday through Saturday.

Residential customers are being notified of their rates through a separate bill insert. To get a copy of those rate schedules, or for streetlighting and power factor rates, call 625-3112.

Your Seattle City Light

Bldg. ID DGR001

Year Built 1981

Primary Use offices

Square Feet 2620

Hours per Week 45

Yearly Consumption - Electrical

1985	
1986	Puget Power
1987	

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	crawl R11
Walls	Wood frame - R11
Ceiling	Flat R11
Windows	Double pane
Sq.ft. windows	290

BLDG. SYSTEMS

Heating	electric resistance baseboards
Air conditioning	one office only
Hot water	electric - 50 gallon
Refrigeration	--
Interior lights	2880 fluorescent - 1.1 w/sq.ft
Exterior lights	490 w HPS
Equipment I	office equipment
Equipment II	--

DGR001 was built in 1981. It is located in a small business office/warehouse park off a high traffic-through street. Here the neighborhood begins to change from heavy industrial to light industrial and apartment buildings.

The 2620 sq.ft. wood frame, rectangular building is divided into 5 spaces. The back center section contains the restrooms, storage areas and a hall which opens to each of the 4 office space.

The wood frame walls have R-11 batt insulation, the flat roof has R-19 batt insulation. The crawl space under the building has R-11 batt insulation. Two thirds of the 290 sq.ft. of clear, double paned windows in aluminum frames face south. Miniblinds help control the solar gain. Heat is provided by electric resistance baseboards in each space. One tenant has added a window mounted air conditioner in one of the small center offices.

Interior lights are overhead fluorescent fixtures, 1.1 watts per sq.ft., with occasional incandescent desk lamps as needed. Exterior lights are high pressure sodium lights.

When the original survey was done in 1985, all offices were occupied. Tenants were a temporary service agency, a collection agency, an insurance agency, and in the larger area a hobby shop. Six months later the collection agency and the hobby shop moved out. A year after the survey, the temporary service moved out, leaving just the insurance agency in the summer of 1986 up to June 1987. Few customers come to the office. Shortly after this the building was dropped from the study.

The units are not individually metered and the owner pays the utility bill. The current tenant says he turns down the heat when he is not there. He has no access to the other units and the doors are locked, so temperature settings in the other units are unknown. The air conditioner is used only when it is hot, otherwise, the front door is used as a ventilating system. The building is in a valley which protects it from the winter wind, but also does not allow the summer breeze to cool the building.

The end use loads are all monitored separately by the FDAS.

AUDITOR'S OBSERVATIONS

The fifty gallon water heater is serving as a space heater in the storage room. A small tank or demand heater would be more efficient. Payback time should be short as the building is paying Puget Power rates (which are about 50% more than Seattle City Light rates). Water temperatures should be set no higher than 110°F as it is only used for occasional hand washing.

More efficient fluorescent lights & electronic ballasts might be indicated when the building is fully occupied. Since few lights are being used at this time the installation costs would not be warranted.

Bldg. ID DGR002	Year Built 1930
Primary Use Sales & Repair	Square Feet 7,046
Hours per week 70	

Yearly Consumption - Electrical - SCL Billing

1985	69,933	9.9 kwh sq. ft.
1986	72,239	10.2 kwh sq. ft.
1987	69,199	9.8 kwh sq. ft.

Available End Use Data

1986 and 1987

BLDG. CHARACTERISTICS

Floor	Basement-crawl-no insulation
Walls	Wood frame - original - no insulation addition - R19
Ceiling	Flat roof-original R3.7
Windows	Original-single pane-wood frame addition-double pane-metal frame
Sq. ft. windows	Single pane-278 Double pane-134

BLDG. SYSTEMS

Heating	Primary-wood stove Secondary-electric baseboard
Air conditioning	None
Hot water	52 gallon electric
Refrigeration	--
Interior lights (Original survey)	8,200 w fluorescent 1,200 w incandescent - 1.34 w/sq.ft.
Exterior lights	--
Equipment I	Shop equipment
Equipment II	--

DGR002. The original 1930 structures were a commercial space with basement and a second story apartment and next to it a small one-story commercial space over crawl space. The two buildings plus a 1983 addition have been combined to form DGR 002. An interesting combination of services are delivered by two business. A bicycle sales and repair shop occupies the entire street level of all three sections, the two basement areas contain storage and workshop. A mezzanine area is used as office space, for a total of 5,814 square feet. A violin repair shop occupies 1,232 square feet on the second floor.

The bicycle shop is a busy, upscale place with all the accessories and clothing as well as bicycles which are presently in vogue. There are several employees and frequent customers who are "on the go" people. The shop has a large lighting load: fluorescent ceiling fixtures throughout plus several incandescent spot and flood lights along the wall display areas. When the original survey was conducted, only fluorescent lights were in the store. Single pane windows are across the street level store fronts and the first floor workshop at the back. The addition with the mezzanine has double pane windows across the back on all three levels.

Heating in the basements is electric resistance baseboards. On the main level heat is provided by a wood stove.

The violin shop in the former apartment on the second floor is very quiet, in contrast to the hectic bicycle shop below. The second floor is reached by an enclosed stairway with an identifying front door at the street level. Very little has been changed from the original. There are original single hung, single pane windows in wood frames which provide much of the light. Artificial light is mostly fluorescent. Heat comes from electric resistance baseboards.

The walls of the original buildings have no insulation. The new addition has R19 in the outside walls. The old flat roofs have R-3.7 insulation. The addition has R38 in the roof. Windows in the old sections are single pane, in the new sections they are double pane. The crawl space under the original small building has the joist space enclosed with wall board, but there is no insulation. The rest of the floors are concrete basement.

DATA

We have quarterly data for 1986 and 1987. The data shows lighting to be the large load, 60 percent to 70 percent of the total and very consistent in amount of consumption. It varies from 10,864 kilowatt hours per quarter to 12,015 kilowatt hours per quarter and five of those quarters are very close to 11,600 kilowatt hours.

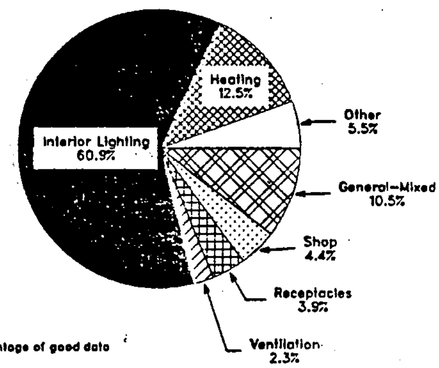
By the end of 1988, the lighting load will probably be higher due to the many new lights added for display purposes.

AUDITOR'S OBSERVATIONS

Lighting load in the bicycle shop could be reduced by using fluorescent flood and fluorescent spot lights. High light levels, which are important in this outdoor type business, could be maintained or improved at a smaller load. This business tends to continually add more lights. The crawl space could be insulated and vented, a fairly simple procedure. Insulating the original walls would be more difficult and would require drilling, blowing in insulation and refinishing walls. The flat roof on the original buildings presents a more involved problem. There is no cavity to which insulation can be added. A complete tear off and installation of rigid foam insulation would be expensive, even if done only when a new roof is needed. But no insulation measures would be recommended as primary heat is wood heat. The violin shop upstairs would be the only area to maybe consider as it has electric baseboard heat. It is a daytime business and the most cost-effective strategy is to turn off the heat when not occupied. Domestic hot water is supplied by a 52 gallon tank 24 hours a day, 7 days a week. An instantaneous or two-gallon hot water heater would be a big saver as there is little demand for great quantities of hot water.

SITE 447 1st Quarter 1986

Share of Total Electricity Consumption 18,318 KWH
by End-Use *

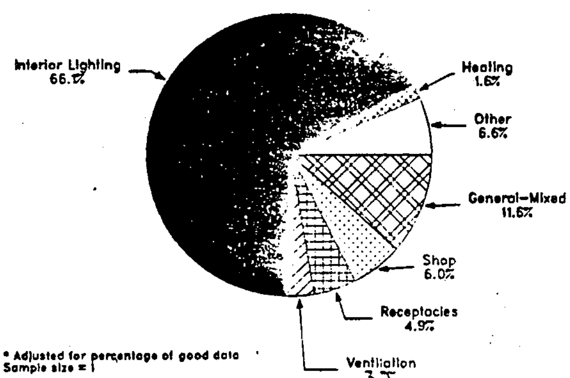


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 447 2nd Quarter 1986

Share of Total Electricity Consumption 17,556 KWH
by End-Use *

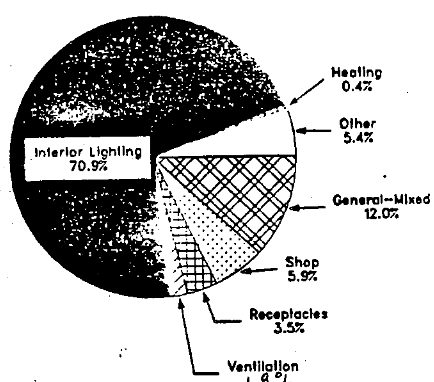


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 447 3rd Quarter 1986

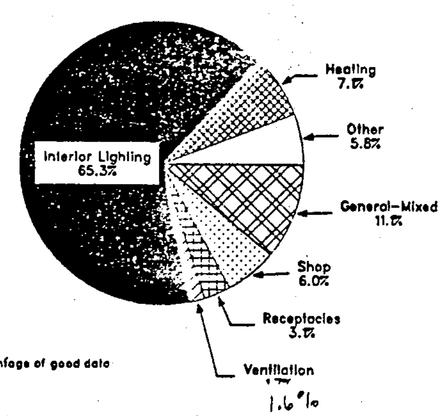
Share of Total Electricity Consumption 16,680 KWH
by End-Use *



ELCAP

SITE 447 4th Quarter 1986

Share of Total Electricity Consumption 17,684 KWH
by End-Use *

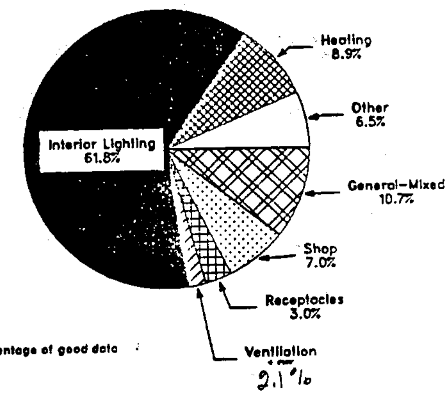


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 447 1st Quarter 1987

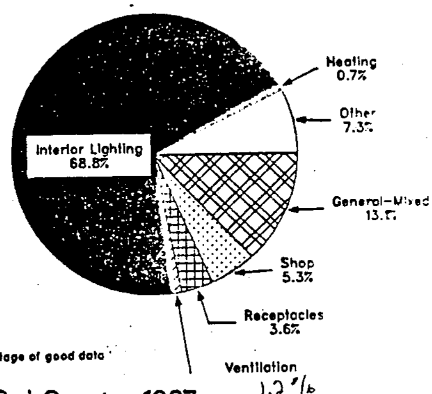
Share of Total Electricity Consumption 19,442 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 447 2nd Quarter 1987

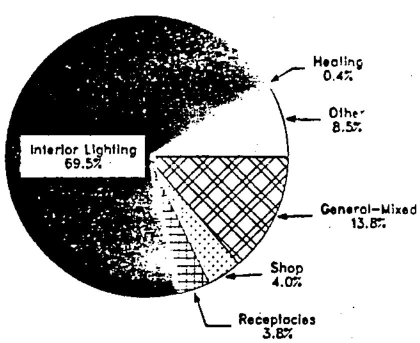
Share of Total Electricity Consumption 16,761 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 447 3rd Quarter 1987

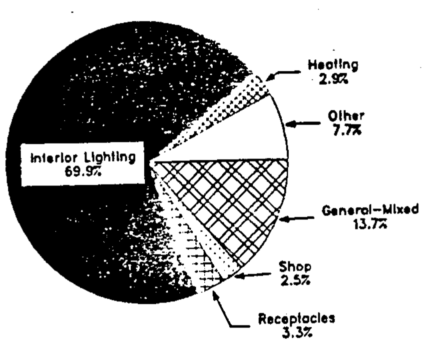
Share of Total Electricity Consumption 15,631 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 447 4th Quarter 1987

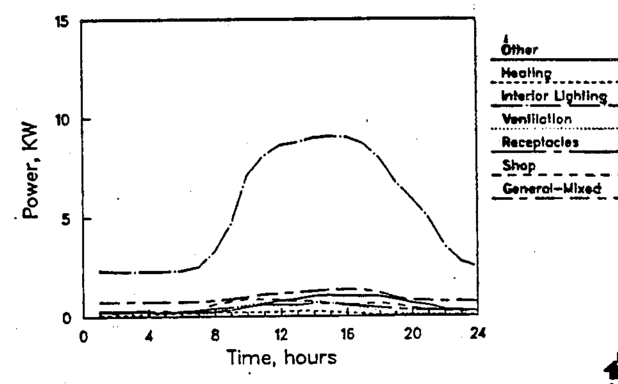
Share of Total Electricity Consumption 16,675 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 447 2nd Quarter 1986

Average Daily Electricity End-Use Profile



Sample size = 1

Bldg. ID DGR004 Year Built 1965

Primary Use Retail store Square Feet 4131

Hours per week 56

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985 - 53,427 - 12.9 kwhs/sq.ft.
1986 - 46,914 - 11.4 kwhs/sq.ft.
1987 - 50,808 - 12.3 kwhs/sq.ft.

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete block
Ceiling	Attic, R-9 batt insulation
Windows	Single pane, metal frame
Sq. ft. windows	204

BLDG. SYSTEMS

Heating	Forced air gas
Air conditioning	Direct expansion
Hot water	40 gallon electric
Refrigeration	Small refrigerator
Interior lights	7590w fluorescent 240w incandescent - 1.9 w/sq.ft.
Exterior lights	660 w fluorescent
Equipment I	Data processing
Equipment II	Receptacles

One of the State's "green front stores," DGR004 is located in a typical 1960's neighborhoond shopping center. The 4,131 sq. ft. liquor store is a one-story, concrete block building with slab or grade concrete floors. There is no inside furring or insulation on the walls. The 10 ft. high, dropped ceiling has R9 batt insulation. The north side, facing the parking lot has 244 sq. ft. of single pane window and glass doors. At the back is a steel exit door. The west adiabatic wall is shared with a dry cleaner/laundry. This heat generating neighbor opens early, several hours before the liquor store and closes at 6 p.m., two hours before the liquor store closes.

The manager observed that the building does not hold heat. Once he was snowbound there--spending the night in the store. Even turning up the gas furnace as high as he could did not help much. At night there was no warm wall next door and no solar heat for the concrete building to absorb. The building was designed for day time use and construction costs were held to a minimum. HVAC is provided by forced air gas furnace, two roof top air conditioners, and by indoor exhaust and outdoor air intake.

Interior lighting consists of 7590 w of fluorescent tubes and 240 w of incandescent bulbs. Exterior lights are 660 w of fluorescent tubes. There is a photocell but it is broken, so the lights are just left on. The end use loads are monitored separately. The receptacles have a small refrigerator, a microwave oven, coffee pot and a wall clock plugged in.

The interior is a big, barn-like structure. Separation of the sales area and the stock room is by open shelves, which are refilled from the back. The restrooms and the manager's office are the only closed off areas.

Data:

We have one month's end-use data for this store, March 1987. The "heating load" is the fan for the gas furnace. It has a steady consumption for 24 hours for every day. The cooling load is on at the same time. Interior lighting, which is 71 percent of the electric load is the only end-use showing changes. These are consistent and in direct response to business hours.

Auditor's Observations and Recommendations:

1. The easiest, most cost-effective measure would be to turn off exterior lights, heating and cooling systems when not needed.

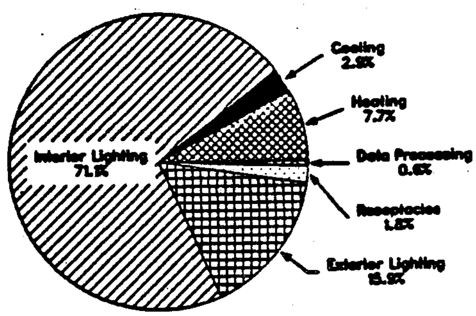
2. The walls would reflect more light if they were painted white, instead of the present gold color. New fixtures with reflectors, efficient ballast and efficient fluorescent tubes would require fewer tubes. This would also have some impact on the heating and cooling loads.

3. When it is time to replace the air conditioners heat pumps could be used. They would provide air conditioning in the summer and at a COP of 2.5 or more would provide very inexpensive electric heat most of the operating hours. When the weather is very cold and the heat pump efficiency falls then the gas furnace could be used for back up heat.

4. The building has a very high U-value. The minimally insulated ceiling is the only protection from outdoor temperature changes. The warm, next door neighbor helps heat the west wall, a plus on cold days, but not in the summer when air conditioning is needed. Adding ceiling insulation would be inexpensive, but other shell measures such as furring out the interior walls, insulating them, and then installing dry wall or insulating the slab on grade floor, or replacing the single pane windows would all be expensive measures and in this building, which is only used in the day time, would not provide significant savings.

SITE 532 3/ 1/87 to 3/31/87

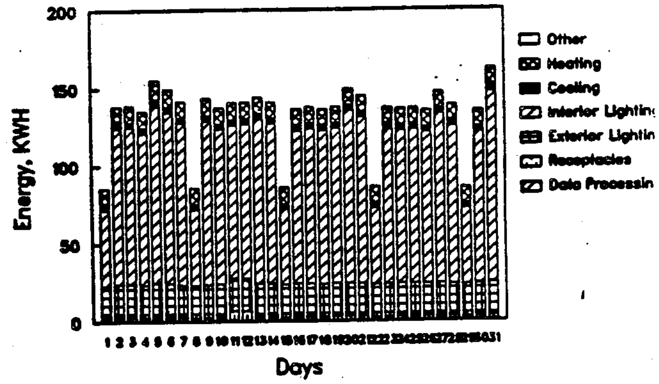
Share of Total Electricity Consumption 4,101 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

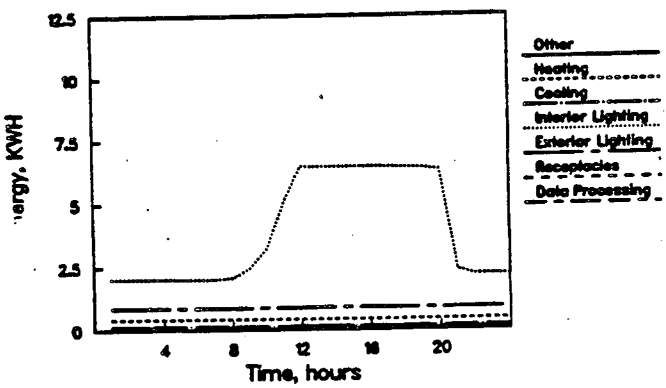
SITE 532 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



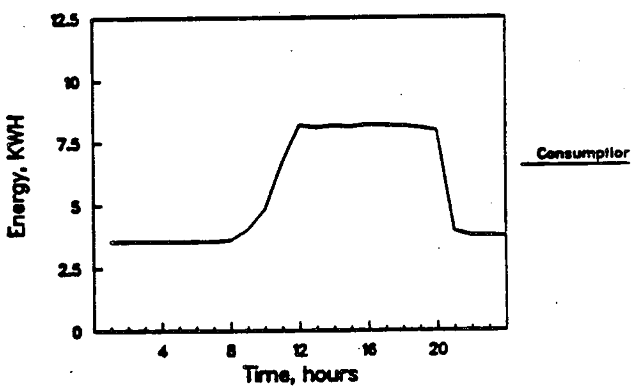
SITE 532 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



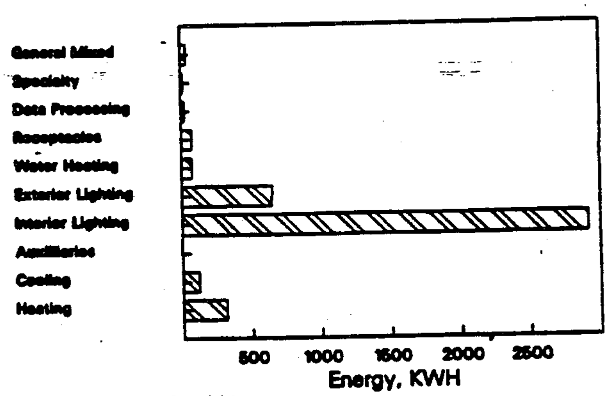
SITE 532 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 532 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID DGR007 — Year Built 1900

Primary Use Deli & Hair Salon — Square Feet 1904

Hours per week Deli - 96
Salon - 48

Yearly Consumption - Electrical - SCL Billing — Available End use Data

NONE

	Hair Salon	Deli	Total
1985	22,760 (23.9 kwh/sq.ft)		
1986	20,859 (21.9 kwh/sq.ft)	71,820	92,679
1987	23,682 (24.9 kwh/sq.ft)	(75.4 kwh/sq.ft)	(48.7 kwh/sq.ft.)
Average	23.5		

BLDG. CHARACTERISTICS

Floor	below grade concrete
Walls	wood frame, brick veneer. No insulation
Ceiling	flat roof, attic, no insulation.
Windows	single pane wood frame.
Sq. ft. windows	511

BLDG. SYSTEMS

Heating	Electric resistance
Air conditioning	only in deli
Hot water	40 gal + 80 gal electric heaters
Refrigeration	large load in deli
Interior lights	3008 w fluorescent 1675 w incandescent - 2.46 w/sq.ft.
Exterior lights	Incandescent, fluorescent, neon
Equipment I	food prep.
Equipment II	salon equipment.

DGR007 is a small building housing three shops. A quick stop deli-convenience store on the corner (17 x 56 ft.), a funky hair salon in the center (17 x 56 ft.) and a bizzare art store (25 x 56 ft.) on the other side. Only the deli and hair salon are included in the ELCAP study. The brick building was built in the early 1900's and not designed for their present use. The deli has a small improvised kitchen at the back, a rest room and crowded store room. The main part of the store has cigarettes, canned and packaged food, a coffee maker, aspirin, candy, paper goods, frozen and refrigerated food, and other assorted products. Refrigerated beer & soft drinks are major items. The check out counter is immediately inside the front door and the clerk does not leave his station, keeping an eye on all who enter and leave, making sure everything is paid for. Very little, other than paint now and then and a change to fluorescent lights, has been done to the interior.

The propriator of the hair salon on the other hand has installed several angled walls, closets, doors and mirrors to give the salon a different look from the original building. Most everything is shining black; walls, sinks and floor. The hairdressers' stations are in the front just beyond a reception desk and a small waiting area. Beyond them are the 2 hair dryers and the door leading to the shampoo room.

Both of these businesses have several pieces of equipment that are a high energy users and heat producers. The deli has 8 refrigeration cases, freezers or refrigerators, an electric cooler and steamer and an 80 gallon DHW tank. The large range is gas. The hair salon has standard hair dryers and several hand held blow dryers, curling irons, 1675w of incandescent spot lights and 1000w fluorescent ceiling lights and an electric 40 gallon DHW tank.

Heat is supplied by a unit heater in each commercial space. A roof top air conditioner serves the deli.

The store front windows on the west are single pane in wood frame. On the north side of the deli there is one, large, wood frame, store window and two smaller high single pane windows in metal frames. At the back facing east on the alley are three smaller high single pane windows in wood frames and a solid wood door to each retail space. The walls are brick with a 3 inch air space finished on the inside with lath & plaster. Below grade walls are concrete. The flat built up roof on wood deck has a 3 ft. air space and then a lath & plaster ceiling. There has never been any insulation in the building.

AUDITOR'S OBSERVATIONS

This building's days are numbered. High rise apartments and condominiums are being built all around it. Any measures taken would soon be torn down with the rest of the building.

Bldg. ID DGR008 | Year Built 1890

Primary Use Retail Hardware Store | Square Feet 7806 gross - unheated 5785

Hours per week 52

Yearly Consumption - Electrical - SCL Billing

1985 - 33,686 - 4.3 kwhs/sq.ft.
1986 - 38,076 - 4.8 kwhs/sq.ft.
1987 - 42,337 - 5.4 kwhs/sq.ft.

Available End Use Data

July and Dec. 1986
3rd & 4th Quar. 1986

BLDG. CHARACTERISTICS

Floor	wood over concrete basement
Walls	wood frame - no insulation
Ceiling	attic - no insulation
Windows	single pane, wood frame
Sq. ft. windows	338 in heated area

BLDG. SYSTEMS

Heating	Forced air gas, electric resistance baseboard
Air conditioning	--
Hot water	Instantaneous electric
Refrigeration	--
Interior lights	9,030 w fluorescent - 1.16 w/.sq.ft. ____ w incandescent
Exterior lights	--
Equipment I	Copier
Equipment II	Coffee pot

DGR 008 is the industrial and marine working man's working hardware store, where a wide variety of tools and supplies can be found. A brick and wood structure built in the 1890's, it is one of the oldest buildings in the ELCAP sample. It is located on the business street of an older, blue collar, neighborhood which is becoming "gentrified."

Very little has been done to this structure. Repairs have been done only when absolutely necessary and in a minimal way. The building retains the original design, woodwork, 14-foot high ceilings in various stages of repair, the old, well worn, wood floors and original glass in some of the windows. The building has settled over the years, nothing is square, but the walls have moved with the doors so there are not large gaps around the sides.

The store is like a step back in time. Equipment is hung from the walls, stacked on counters or on the floor. There are high shelves and clerks to get the items you want. There are no color-coordinated marketing displays or clean, shiny shelves with the UPC markings or automated checkout counters. The copier is hidden away in the upstairs office.

When built there were two stores, each with their own store front entrance. The unheated store and the heated store each have 187 sq. ft. of single pane window on this side. Offices upstairs were reached by a wide, outside center stairway from the front sidewalk. The original wood steps are still in use.

One concession to modern improvement is the lighting, it is no longer gas light or electric incandescent, but fluorescent on the main floor, the upstairs office and storage. There are incandescent bulbs in the basement storage and part of the first floor. The instantaneous electric hot water heater is another innovative energy saver in the building. Another change has been the replacement of some windows. All windows are single pane, but some now have metal frames, instead of the original wood frames. At the top of the stairs is a large, single-glazed skylight which provides light, and on sunny days, considerable solar heat. The hardware store has been there since 1932 and occupies the entire building. A door has been installed between the two store areas. A ceiling-mounted gas furnace with a blower is installed in the 1429 sq. ft. sales area. The south side "store" is an 2213 sq. ft. unheated storeroom. Upstairs is 3572 sq. ft. storage area with a small office and an employee lunchroom, total of 592 sq. ft. They each have an electric baseboard heater. Tall 3.5' x 6' windows face the street. The basement, which is also used for storage is unconditioned. The building has a flat roof. There is a 3 foot cavity above the ceiling, it contains no insulation. The outside walls are brick with lath and plaster, no insulation. The interior walls, separating heated from unheated areas, are lath and plaster on each side with no insulation in the cavity. The outside north wall adjoins another building in the row of commercial buildings. On the south side is a vacant lot.

Employees have stated that the building's unconditioned spaces are cold and drafty in the winter. The upper level gets very warm in sunny weather. Reliable data for six months gives us a good picture of what goes on in the building. The first observation is that this is a low commercial consumer of electricity using about 3000 kwh's a month in summer and 4500 kwh's a month in winter. Annual consumption is about 5 kwh/sq. ft. Lighting is the major part of the load all year, accounting for up to 94% in summer and about 80% in winter. (See 3rd and 4th quarter graphs.) Electric heat in the office accounts for about 15% of the load in winter (the sales area is heated with gas). Water heating is extremely small all year. The instantaneous water heater has no standby loss. The receptacles and "specialty," which include equipment in office, power tools, cash register, etc. are also small loads which appear on graphs #3 during business hours.

The use patterns are very consistent. Weekends and holidays are evident on graphs #2. We can see that someone forgot to unplug something on the third of July and it stayed on for the long weekend. This load does not appear on other weekends. Thanksgiving looks just like a Sunday. But on Christmas Eve, someone left the heat on in the office. It shows a greater use for Christmas day than for any other day, indicating the unusual overnight use.

There are no automatic timers and the humans who control things are very consistent. The morning lighting load (graphs #3) always show a dip in early afternoon than a slight rise in the late afternoon before the closing time. Some lights are left on at night for security.

Auditor's Observations and Recommendations:

Probably the most cost-effective and easiest measures would be:

1. Insulate the ceiling. This should make the buildings warmer in winter and cooler in summer.

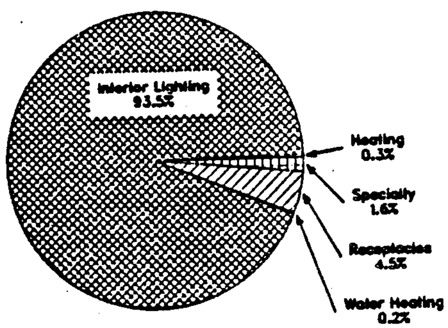
2. Change the basement and other incandescent bulbs to fluorescent lights.

3. A shade for the skylight in the summer would make the second floor more comfortable.

Any major energy savings measures would be very expensive, such as insulating the walls, changing out the windows to double pane or changing the heating system. If the building would be designated a historic site and/or the entire structure was conditioned space some of these measures should be explored.

SITE 546 3rd Quarter 1986

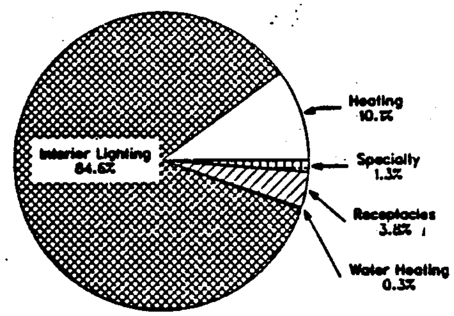
Share of Total Electricity Consumption 9,389 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 546 4th Quarter 1986

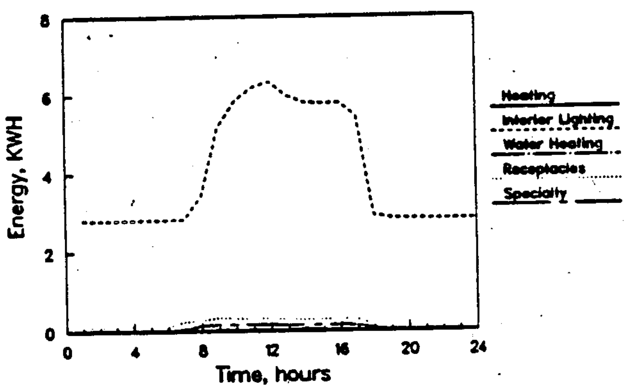
Share of Total Electricity Consumption 11,493 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

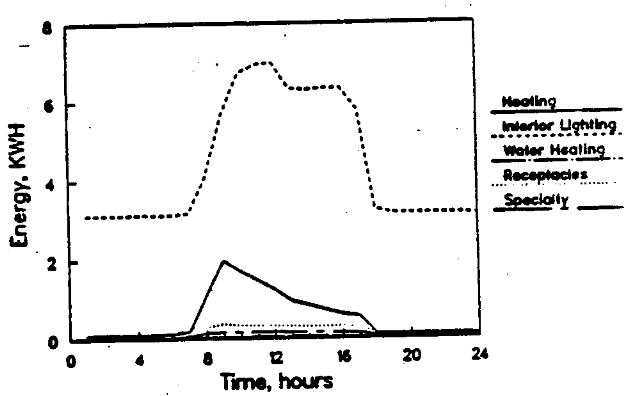
SITE 546 3rd Quarter 1986

Average Daily Electricity End-Use Profile



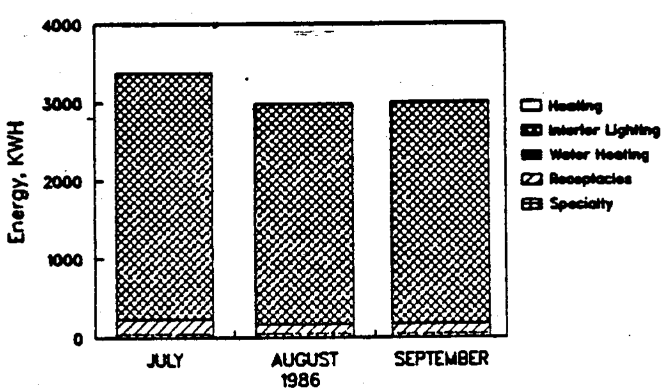
SITE 546 4th Quarter 1986

Average Daily Electricity End-Use Profile



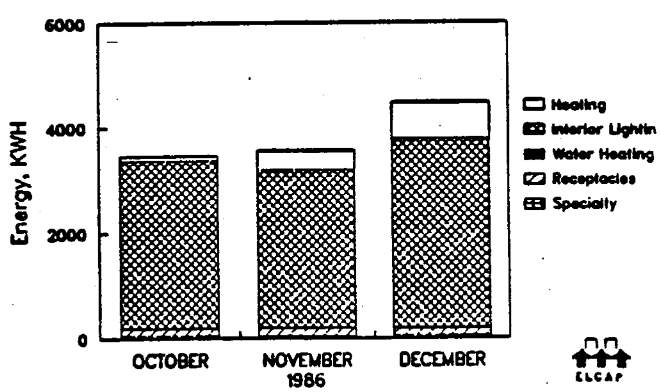
SITE 546 3rd Quarter 1986

Total Monthly Electricity Consumption by End-Use *



SITE 546 4th Quarter 1986

Total Monthly Electricity Consumption by End-Use *



ELCAP

Bldg. ID DGR009

Year Built 1959

Primary Use Department Store

Square Feet 20,819

Hours per week 71

Yearly Consumption - Electrical

1985 Puget Power
1986
1987

Available End Use Data

Quarterly reports for 1987 and 1st Quarter of 1988

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Concrete and brick, no insulation.
Ceiling	Flat built-up roof. R5 insulation.
Windows	Single pane in metal frame.
Sq. ft. windows	464

BLDG. SYSTEMS

Heating	Primary--forced air gas. Secondary--electric resistance.
Air conditioning	Direct expansion. Heat pump for office.
Hot water	52 gallon electric
Refrigeration	--
Interior lights (At time of survey)	27,990 w fluorescent -0- w incandescent - 1.34 w/sq.ft.
Exterior lights	NONE
Equipment I	--
Equipment II	--

DGR009 is a small, 20,819 square foot branch of a large international department store chain. It is not a full service store, but is primarily a clothing store. It also has a catalogue department where furniture, tools and housewares can be ordered.

It was built in 1959 as part of a large, strip shopping center in a developing suburb. The surrounding area has grown and expanded, making this store appear even smaller. There have been no structural changes since it was new. The lighting was upgraded in 1981. In the fall of 1987 it was again changed to more efficient lights with improved lighting levels. The 1986 ELCAP survey will be revised with the 1987 improvements.

The concrete and brick building has no wall insulation. The flat built-up roof has R5 insulation. The 464 square feet of windows are single pane in metal frames. The floor is concrete slab on grade. The square, free standing building is one story with a 1,330 square foot mezzanine which houses offices and restrooms. The ceiling is 21 feet high in the main sales area and 10 feet high under the mezzanine.

Because it is a small store, the merchandise is crowded into every available square foot. Some relief and special highlighting of items is afforded by displays up on the walls and raised displays on the floor. These are highlighted with several incandescent spot lights.

The store is open every day except Thanksgiving, Christmas and Easter. Hours are 9:30 a.m. to 9 p.m. Monday through Friday, 9:30 a.m. to 6:00 p.m. on Saturday and noon to 5 p.m. on Sunday.

DATA

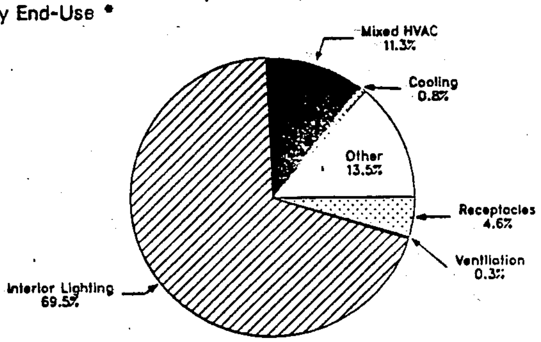
Basic lighting at the time of the survey was 40 watt fluorescent ceiling lights. These were replaced by fewer and more efficient fluorescent lights and ballasts. Track spot lights were added in selected areas. The reduction in the interior lighting load is apparent in the graphs for the first quarter of 1987--41,517 kilowatt hours and the first quarter of 1988--33,753 kilowatt hours, a dramatic 20 percent decrease amounting to about $1,400 in savings a year on lighting. These savings are a result of a later turn on time in the morning, and the lower installed wattage. Other benefits are improved appearance and savings in HVAC. We do not yet have the summer data for 1988, but should see a decrease in the HVAC, except for September 2, 1988, the hottest day in Seattle's history, 98° F.

AUDITOR'S OBSERVATIONS

The change to efficient lighting and a later turn on time starting the third quarter of 1987 has shown an immediate reduction in kilowatt hours. The energy manager for this chain is very interested in improving operation and efficiency in all the stores. He has installed a simple programmable set-back thermostat for the gas furnaces. He keeps very good records and can easily show the cost and savings from measures installed in various stores. He also realizes that a major building retrofit with insulation in the walls, double pane windows, etc., would not be cost effective for this building. The other aspect he is very aware of is the effect of different managers controlling systems. In the larger stores, energy management systems are being installed and he will soon be able to trouble shoot all the stores in the region via his office computer.

SITE 751 1st Quarter 1987

Share of Total Electricity Consumption 59,736 KWH by End-Use *

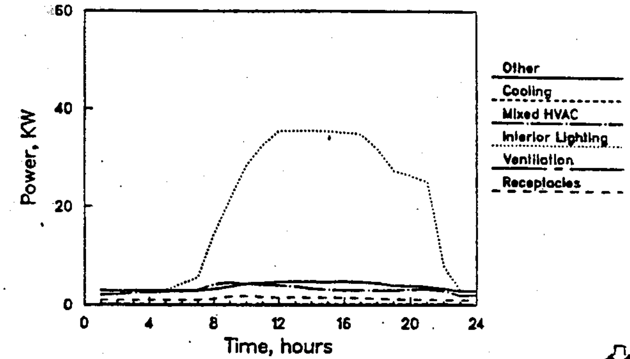


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 751 1st Quarter 1987

Average Daily Electricity End-Use Profile

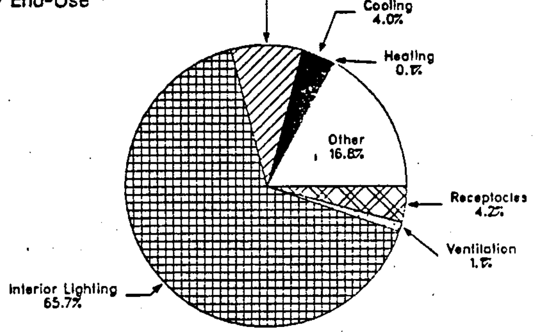


Sample size = 1

ELCAP

SITE 751 1st Quarter 1988

Share of Total Electricity Consumption 61,374 KWH by End-Use *

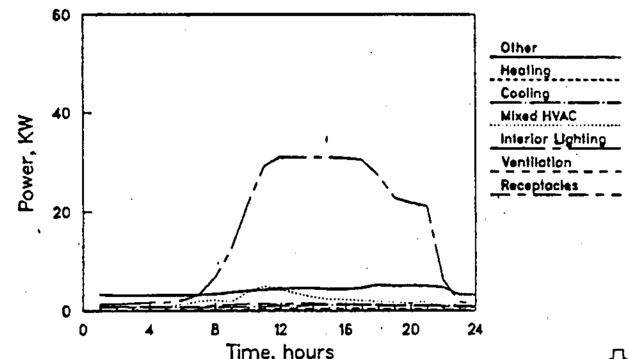


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 751 1st Quarter 1988

Average Daily Electricity End-Use Profile

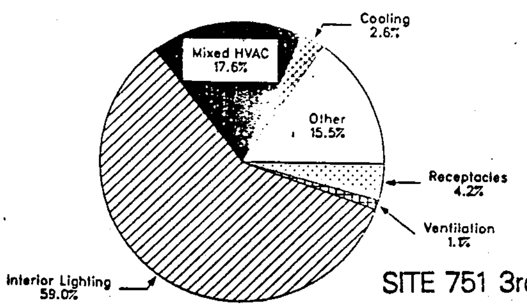


Sample size = 1

ELCAP

TE 751 2nd Quarter 1987

are of Total Electricity Consumption 61,424 KWH
End-Use *



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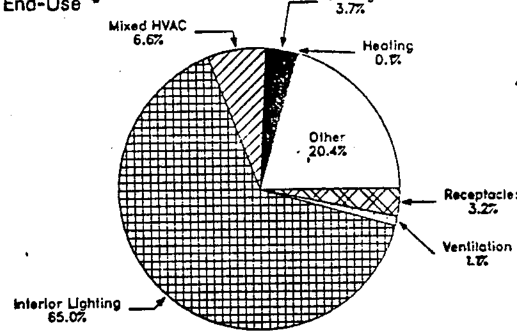
ple size = 1

SITE 751 4th Quarter 1987

Share of Total Electricity Consumption 53,620 KWH by End-Use *

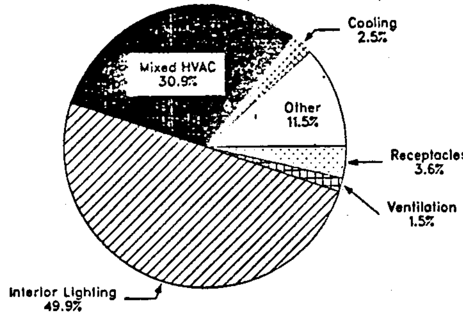


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 751 3rd Quarter 1987

Share of Total Electricity Consumption 67,281 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID DGR010 Year Built 1930

Primary Use Repair Square Feet 2,056

Hours per week 36 - 8 months a year

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985 - 5,800 - 2.8 kwh/sq.ft. June - Sept. 1986
1986 - 6,750 - 3.3 kwh/sq.ft.
1987 - 10,912 - 5.3 kwh/sq.ft.

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Wood, no insulation
Ceiling	Deck, no insulation
Windows	Single pane in wood frame
Sq. ft. windows	320

BLDG. SYSTEMS

Heating	Wood stove
Air conditioning	--
Hot water	Electric
Refrigeration	--
Interior lights	540 w fluorescent 575 w Mercury vapor - .5 w/sq.ft.
Exterior lights	
Equipment I	Machine tools
Equipment II	Welder

DGR010, a small repair business, is like the house that Jack built. About 1930 it started as a gas staion with one small building. Two more sections were added at later dates, giving the building a "T" shape and a total of 2,056 square feet of floor space. In 1981 the present owner started operating a sharpening and repair business in the shed-like buildings. The business is seasonal, lawn mowers and saws are the major items worked on. The owner closes the shop for four months of the year, November through February. The rest of the year the shop is open 11 a.m. to 5 p.m., Monday through Saturday. There is usually one employee, sometimes two.

The building was constructed to be a workshop. Floors are concrete slab on grade. The woodframe walls have plywood or T-1-11 on the outside and a vapor barrier and plywood paneling on the inside. The ceilings are 1256 sq. ft. of flat, hot tar built up roof with no insulation, 480 square feet of plywood with shingles and with another 320 sq. ft. of fiber glass skylight running the length of the section. Under this section there is a four inch air space and a clear visqueen vapor barrier.

There are 311 sq. ft. of single pane windows in wood frames, 168 sq. ft. face east, the front of the building. The building is never open after dark and there are no exterior lights. Interior lighting is 540 w of fluorescent ceiling fixtures and two HID lights, one 175 w and one 400 w for particular task lighting. Water is heated electrically, the tank is wrapped.

The only heat, when needed, is furnished by a wood stove (made out of an oil drum) located at the center of the T junction. There is a forced air gas heater but the gas is disconnected. The fan is sometimes used for air circulation.

Fashionable decor and lighting is not a major concern. The new coke machine and air compressor are the most "artistic" items in the shop which is a functional, no nonsense, blue collar kind of work place. The major electric equipment consists of various grinders, sanders, welder, sharpener, drill press, compressor, etc. These are used to work on the machinery brought to the shop for repair.

Data:

For this small site we have data for four months, June 1986 through September 1986. There is very little variation in the average consumption patterns. But from the daily graphs we see wide daily variations. The last week of September has high shop consumption but low lighting load. This may have been when the coke machine was added and is being monitored on a "shop" circuit.

The hot water cycles on and off 24 hours a day rising about .1 to .2 kwh above the nightime peaks. Most of the energy for hot water is used for standby loss.

Auditor's Observations and Recommendations:

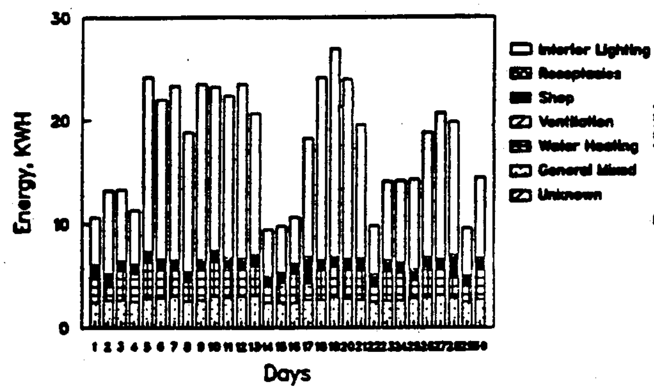
1. Because of the limited use of the building, six hours, six days a week, eight months of the year, changes in the shell would not be recommended. Heating is minimal and primitive, but adequate for the occasional need.

2. Efficient fluorescent lights would save only about \$ .30 - \$ .40 a month. If a new water heater is needed an instantaneous one would save almost all the energy now used for hot water or about \$2 a month.

Conservation opportunities are very limited in this type of building which uses a minimal amount of electricity.

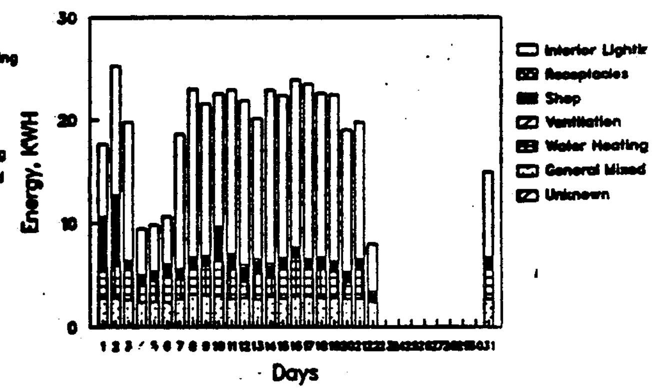
SITE 716 6/ 1/86 to 6/30/86

Total Electricity Consumption by End-Use *



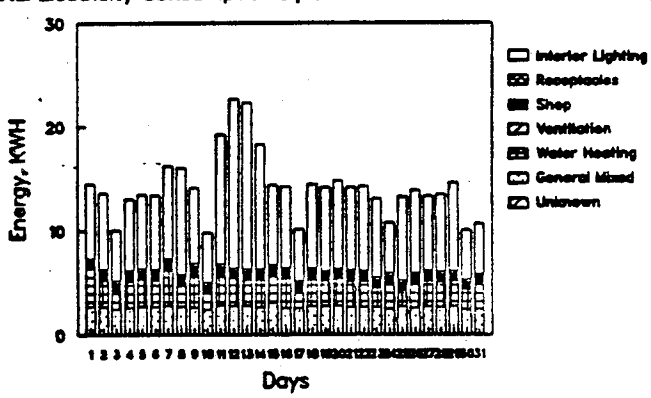
SITE 716 7/ 1/86 to 7/31/86

Total Electricity Consumption by End-Use *



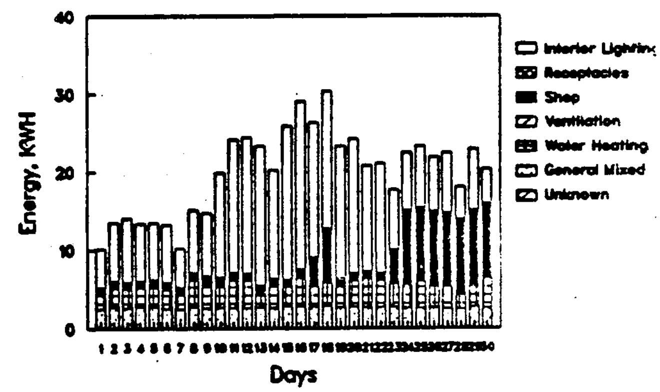
SITE 716 8/ 1/86 to 8/31/86

Total Electricity Consumption by End-Use *



SITE 716 9/ 1/86 to 9/30/86

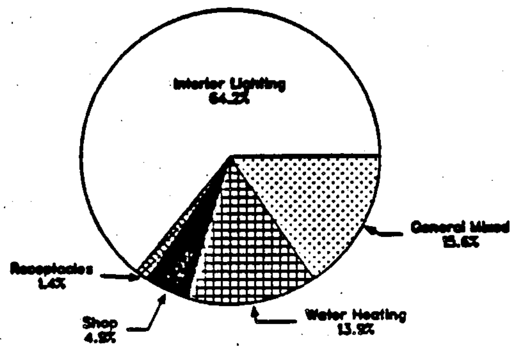
Total Electricity Consumption by End-Use *



ELCAP

SITE 716 6/ 1/86 to 6/30/86

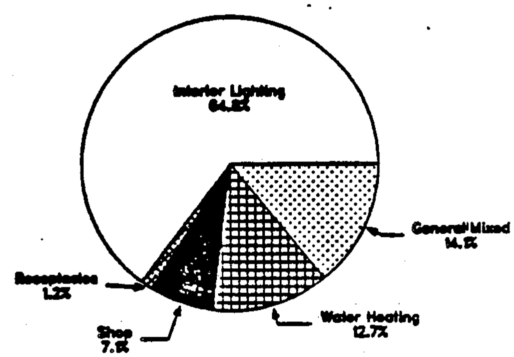
Share of Total Electricity Consumption 529 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 716 7/ 1/86 to 7/31/86

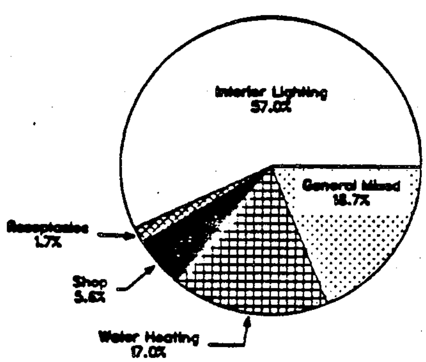
Share of Total Electricity Consumption 610 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 716 8/ 1/86 to 8/31/86

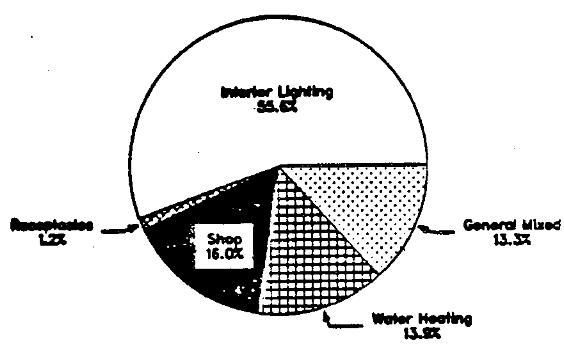
Share of Total Electricity Consumption 440 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 716 9/ 1/86 to 9/30/86

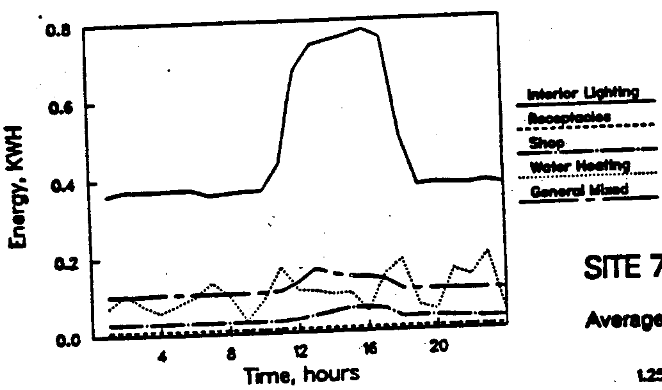
Share of Total Electricity Consumption 600 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

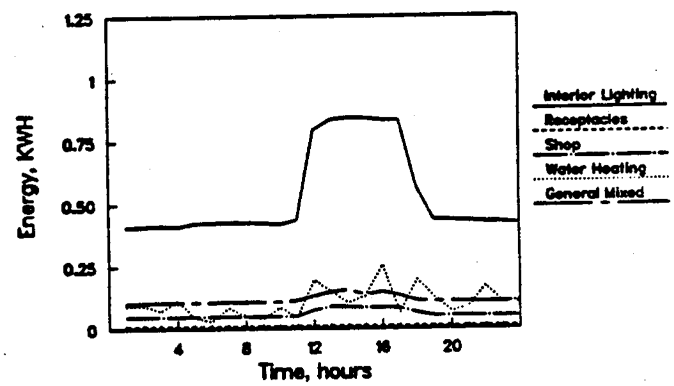
SITE 716 6/ 1/86 to 6/30/86

Average Daily Electricity End-Use Profile



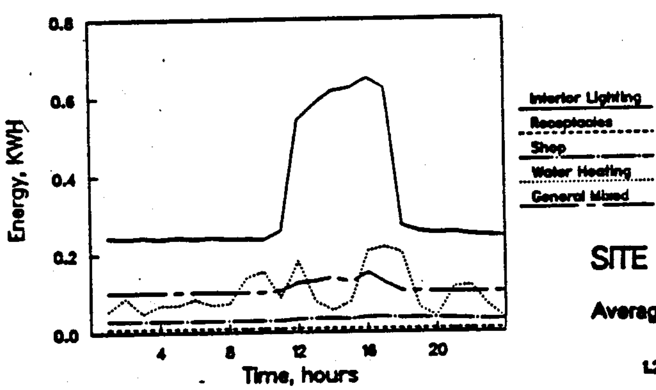
SITE 716 7/ 1/86 to 7/31/86

Average Daily Electricity End-Use Profile



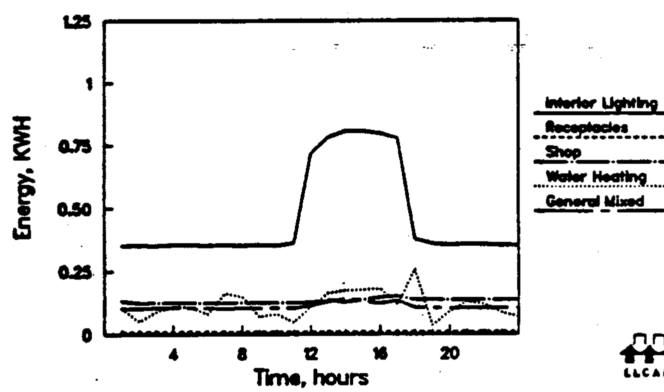
SITE 716 8/ 1/86 to 8/31/86

Average Daily Electricity End-Use Profile



SITE 716 9/ 1/86 to 9/30/86

Average Daily Electricity End-Use Profile



Bldg. ID	DGR011	Year Built	1937
Primary Use	Retail Store	Square Feet	2,330
Hours per week	46		

Yearly Consumption - Electrical - SCL Billing

1985 - 19,112 - 8.2 kwhs/sq.ft.
1986 - 21,654 - 9.3 kwhs/sq.ft.
1987 - 23,394 - 10.04 kwhs/sq.ft.

Available End Use Data

April, July, August, September 1986

BLDG. CHARACTERISTICS

Floor	Basement or concrete slab on grade.
Walls	Wood frame. R-11 insulation.
Ceiling	Wood decking. R-11 insulation.
Windows	Primary - single pane, wood frame.
Sq. ft. windows	203 sq. ft.

BLDG. SYSTEMS

Heating	Forced air gas. 3100w electric resistance.
Air conditioning	--
Hot water	Gas.
Refrigeration	--
Interior lights	7940w incandescent. > 3.4w/sq.ft.
Exterior lights	55w incandescent.
Equipment I	--
Equipment II	--

DGR011 is a retail art gallery near a university campus. The 1937 building was originally a house, but as the area became more commercial, the house was used for retail space. The art gallery has occupied the building since 1974. The owners have made several changes to accommodate the building to their purpose. The original structure is 836 sq. ft. on each floor (basement and first floor). Both are used for gallery space. A 658 sq. ft. single floor addition creates an attractive entrance area and more gallery space.

The gallery is open from 11 a.m. to 5 p.m. seven days a week and until 9 p.m. on Thursdays. There are usually one or two employees in the building and two or three customers. When there is a special show, such as their annual marine art show each summer, there will be several more people at a time.

One of the owners lives next door, so is at the gallery at odd hours to prepare exhibits or do other work.

The art work varies from the traditional oils, water colors and sculptures to untraditional pieces such as a beautifully shaped glass bowl on a pedestal in the foyer and pictures made of torn paper in wonderful colors. The pieces are scaled to your own home, rather than designed just for a gallery.

To allow more natural light in the gallery the roof has been reconstructed to form high sloped ceilings which have R-11 batt insulation. Above grade walls are tongue and groove exterior siding, R-11 batt insulation and gypsum wall board on the interior. Below grade walls are eight inch concrete. Floors are concrete basement or concrete slab on grade. Tall, narrow, palladian windows are single pane in wood frame. They have been placed strategically to admit daylight to the galleries. The basement windows are ordinary single pane in aluminum frames. Doors are solid core wood. Heat is provided by a forced air 80,000 BTU gas furnace in the basement of the original structure and 3100w's of electric baseboard heat in the addition. There is no air conditioning. Some of the windows open to admit fresh air. Hot water for the rest room comes from a 40 gallon gas water heater. At one time one of the owners turned off the water heater. But one of the other owners wanted hot water in the rest room. The water heater is back on, but turned down to low.

The greatest electrical use is interior lighting, 7940 watts installed, which is needed to display the art work during business hours. 550 watts of exterior lights are on a time clock. The owners are not satisfied with the interior lights, particularly the 100 watt spot lights down the center of the galleries. They would like smaller lights, closer to the walls, to better highlight the art work. They also dislike the heat build up from the spot lights.

Data:

Graphs for April, July, August and September 1986 show the electric consumption is greater in April than in the summer months. However, the percentage for each end use remains relatively consistent. The daily consumption graphs, #2, and the average hourly graphs, #3 and #4, are on different scales, making it somewhat difficult to compare them. The high lighting load makes a dramatic appearance on all graphs as it dominates the end uses.

Most of the graphs reflect the hours the gallery is open. The Fourth of July and Labor Day, the only days closed during these months, almost disappear from the charts. While consumption is lowest in August it is also more erratic, reflecting less and more varied times of activities.

The setting changes on the time clock for the exterior lights can be seen on the general mixed load.

Electric heat is a very small portion of the load, even in cool weather, as would be expected in a building which has gas as the primary heating fuel and has a high lighting level.

Auditor's Observations and Recommendations:

1. Lighting presents the best opportunity for energy savings. It is the largest user of electricity and the easiest to change. The owners already have some thoughts about this measure.

Low wattage M16's and fluorescent spot lights could cut the consumption by up to two-thirds, provide more effective lighting and reduce the undesirable heat build up. Exterior lights could be changed to high pressure sodium.

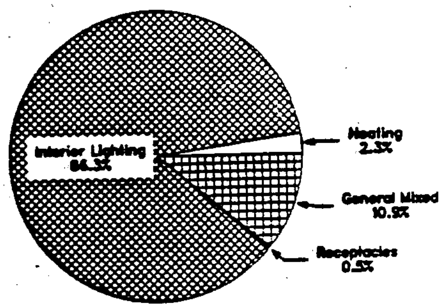
2. An energy conservation measure for the gas consumption would be an instantaneous water heater to replace the 40 gallon water heater now in use 24 hours a day.

3. Because this is primarily a daytime use building with high internal gains, from the flood lights, gas water heater and the sun, no shell measures would be recommended.

4. A heat pump for the addition would provide heat at greater efficiency than the present resistance heat plus flood lights. It would also provide some welcome cooling in the summer.

SITE 610 4/ 1/86 to 4/30/86

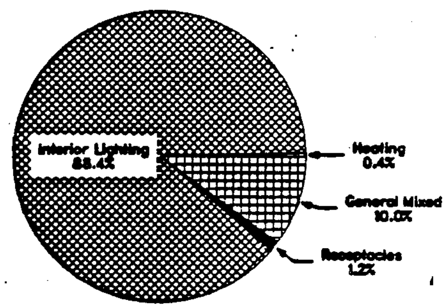
Share of Total Electricity Consumption 2,144 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 610 7/ 1/86 to 7/31/86

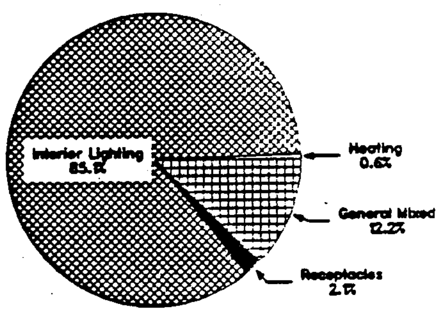
Share of Total Electricity Consumption 1,856 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 610 8/ 1/86 to 8/31/86

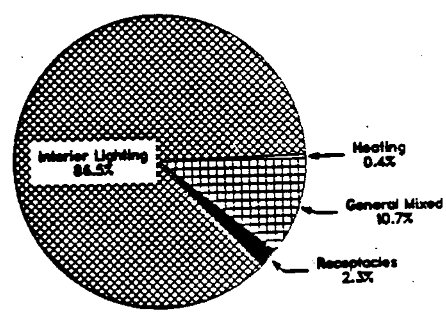
Share of Total Electricity Consumption 1,301 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 610 9/ 1/86 to 9/30/86

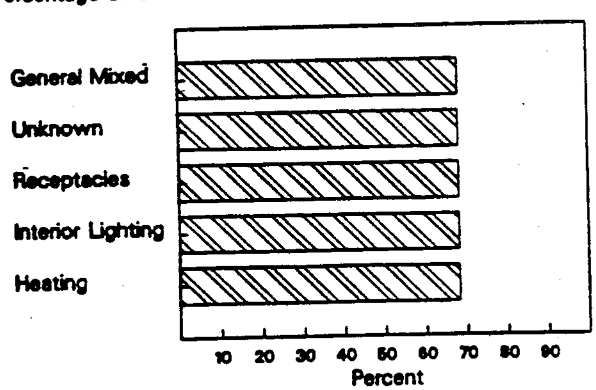
Share of Total Electricity Consumption 1,751 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 610 4/ 1/86 to 4/30/86

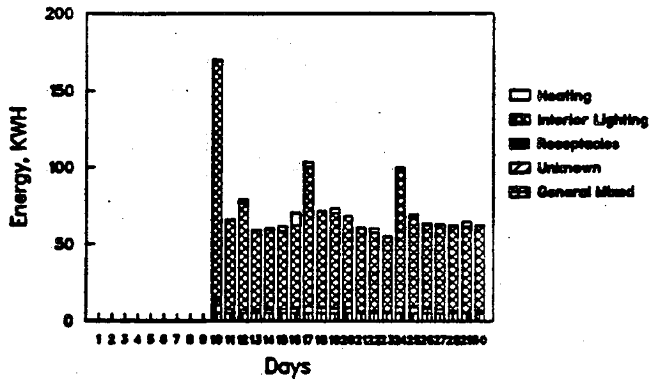
Percentage of Good Data



ELCAP

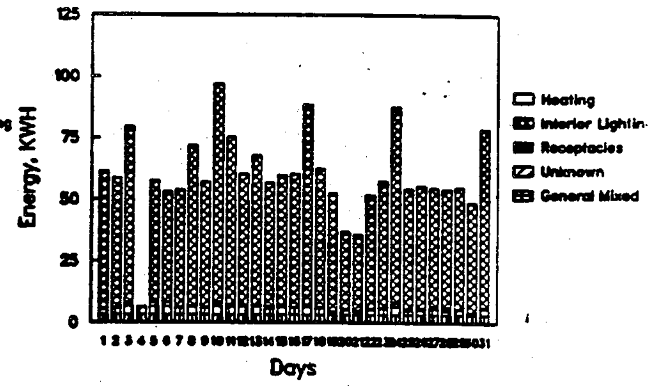
SITE 610 4/ 1/86 to 4/30/86

Total Electricity Consumption by End-Use *



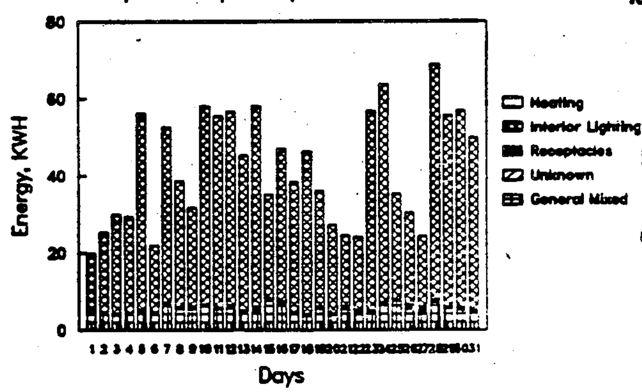
SITE 610 7/ 1/86 to 7/31/86

Total Electricity Consumption by End-Use *



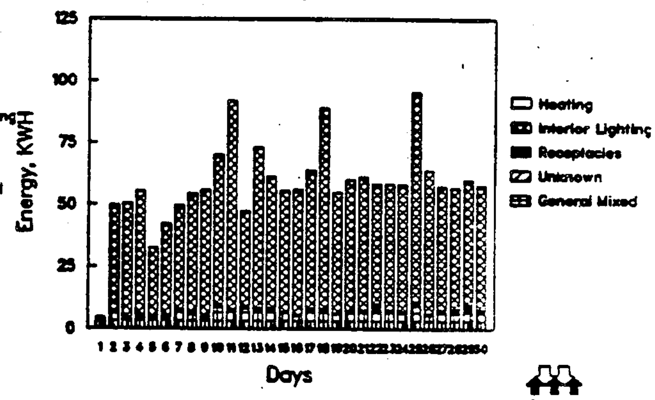
SITE 610 8/ 1/86 to 8/31/86

Total Electricity Consumption by End-Use *



SITE 610 9/ 1/86 to 9/30/86

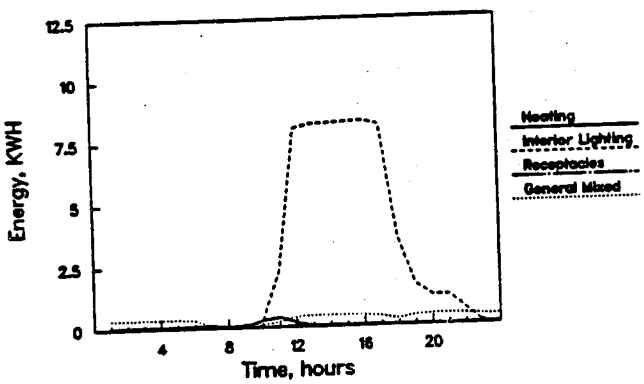
Total Electricity Consumption by End-Use *



ELCAP

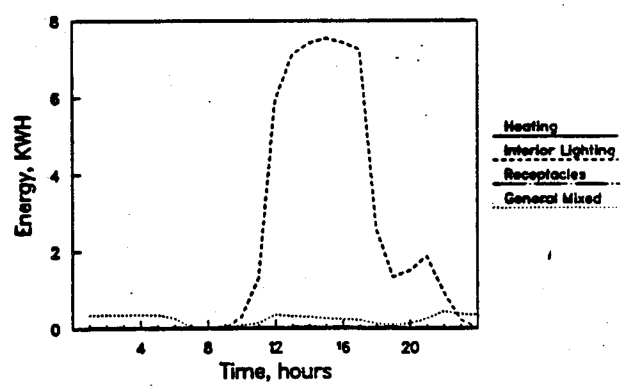
SITE 610 4/ 1/86 to 4/30/86

Average Daily Electricity End-Use Profile



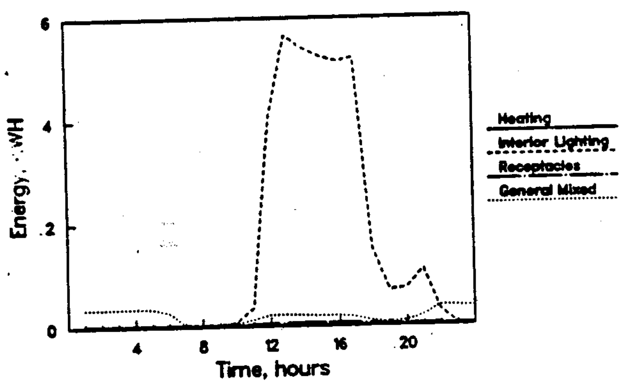
SITE 610 7/ 1/86 to 7/31/86

Average Daily Electricity End-Use Profile



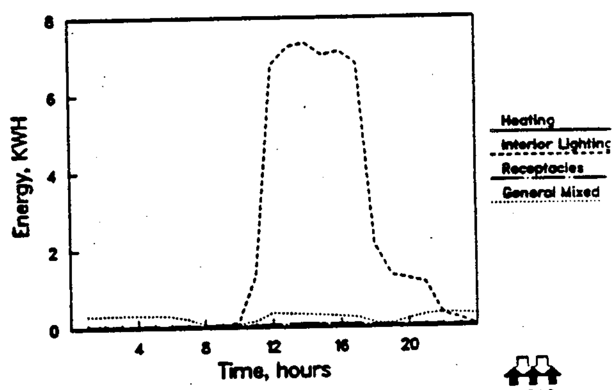
SITE 610 8/ 1/86 to 8/31/86

Average Daily Electricity End-Use Profile



SITE 610 9/ 1/86 to 9/30/86

Average Daily Electricity End-Use Profile



ELCAP

Bldg. ID DGR012 | Year Built 1946

Primary Use Mixed retail, office - process | Square Feet 14,960

Hours per week 45

Yearly Consumption - Electrical - SCL Billing

1985	272,640 kwhs	- 18.2
1986	178,240 kwhs	- 11.9
1987	222,480 kwhs	14.9

Available End Use Data

Aug. and Sept. 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete block
Ceiling	R-11 rigid insulation - 1988
Windows	Double pane in metal frames - 1988
Sq. ft. windows	698

BLDG. SYSTEMS

Heating	2 - constant volume - heat pumps with electric resistance back-up
Air conditioning	
Hot water	40 gallon electric
Refrigeration	--
Interior lights	7,484 w fluorescent - .5 w/sq.ft - 1987 290 w incandescent
Exterior lights	--
Equipment I	Blueprint machines -
Equipment II	Photo equipment
Equipment III	Process hot water

DGR 012 was built in 1946 and has been occupied by a blueprint processing and supply company since 1971. The 44 ft. by 170 ft. building has a concrete slab on grade floor and eight inch concrete block walls. When the original survey was done there were 144 square feet of single pane window on the south wall--the front of the building--and 384 square feet of skylights on the roof which slopes to the east and the west. These were all changed to double pane early in 1988 and 170 sq. ft. of double pane windows were added on the east wall of the first floor. Also the old batt insulation which was in disrepair was removed and two inches of rigid foam was installed on the sloped rafters and covered with 3/8 inch gypsum wallboard.

When first included in the ELCAP study only the first floor was occupied and used by the building owner's blueprint shop and the supply store. The second floor had been used in the past but not by the present business. The wiring and HVAC system were there but not being used.

The front door, facing south onto the street, opens to a small entrance with an office on the left, a hallway straight ahead, then the staircase to the second floor and to the right, a storage area. This area is being reconstructed to make it more usable. The owner has moved from the small cramped offices of the first floor to much larger, high ceilinged spaces on the second floor.

The retail blueprint and office supply business and the blueprint shop occupy the rest of the first floor. Nothing has been changed in that area since the original survey.

The second floor now has offices, rest room and lunch room at the front and a power sewing machine shop in the back. There is a second stairway from the center of the east side to the second floor. New fluorescent fixtures are being installed, additional equipment has been moved into the building and as spaces are renovated and new tenants move in, more equipment will be added.

The new insulation and converted windows improve the thermal value of the building. The new 170 sq. ft. of double pane windows on the east side are higher thermal value than the solid concrete block wall. They also provide daylighting and radiant heat from the morning sun and from the asphalt parking lot.

The major energy uses in this building are the equipment and process water heating in the blueprint shop and the HVAC system. HVAC is two heat pumps with supply and exhaust fans and electric resistance back-up heat. Domestic hot water comes from a 40 gallon electric water heater on the first floor.

Data

The attached graphs are from August and the first two weeks of September 1987. The owner had requested information about the amount of energy used by the equipment in the blueprint shop so he could determine their share of the total electric load. This information was given to him in June 1988.

Graphs #1 show half of the electric energy, 6469 kwhs a month, were being used by the shop equipment. Graphs #2 and #3 indicate the HVAC system is left on 24 hours, seven days a week and is responsive to outdoor temperatures as well as internal heat gains. The weekend of August 8 and 9 was several degrees above normal and the weekend of August 15 and 16, several degrees below normal.

The owner immediately picked up on the heat and air conditioning operating at the same time and at night and on the weekends. He plans to change the settings on the systems.

Observations and Recommendations

The renovation of the building is improving the thermal value of the building as today's products--rigid foam insulation, sealed double pane window units and fluorescent lights--are being used rather than 1946 products.

A larger impact on consumption will be the addition of more people and equipment as 100 percent of the building, rather than 50 percent, is used.

Opportunities for electric savings are:

1. Resetting the HVAC system, a no-cost measure which offers considerable savings.

2. Insulation for the hot water tanks would save heating of water and also cut down on the escaped heat which the air conditioner must then handle. At time of replacement of the DHW tank a smaller or instantaneous water heater could be installed.

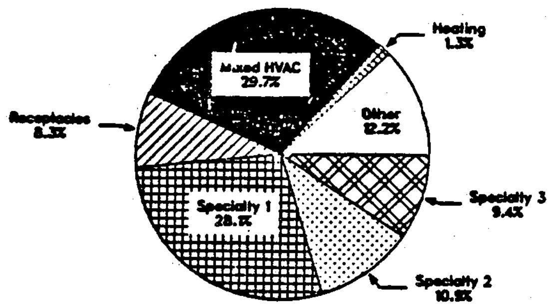
3. Movable, sun filtering covering for the 384 sq. ft. of skylights in the sloped ceiling and the 144 sq. ft.of south facing windows would allow control of solar gains, desirable on cold days to supplement the heat, but undesirable on hot days when the air conditioning must be used to overcome the excess heat gain.

4. The processing equipment is a big user of electricity and also contributes unwanted heat most of the year. When it is replaced the efficiency should be considered. More efficient equipment uses less electricity and produces less waste heat.

5. Since the building has high internal heat gains and is only used during the day, extensive shell improvements, such as wall insulation or more ceiling insulation, would not be recommended.

SITE 723 8/ 1/87 to 8/31/87

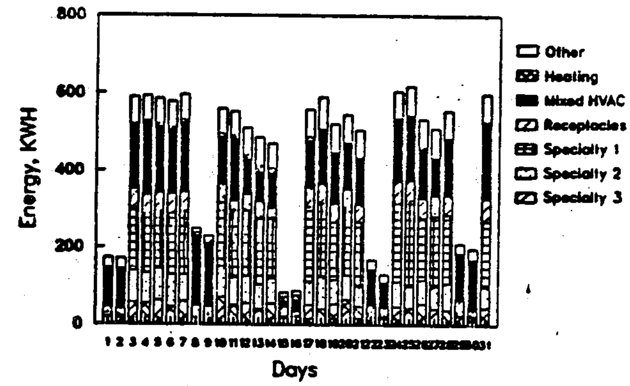
Share of Total Electricity Consumption 13,365 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

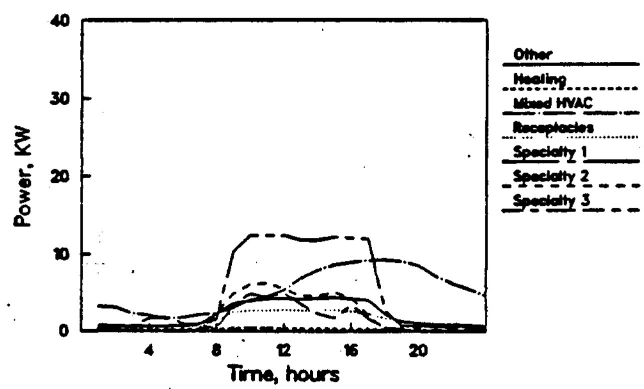
SITE 723 8/ 1/87 to 8/31/87

Total Electricity Consumption by End-Use *



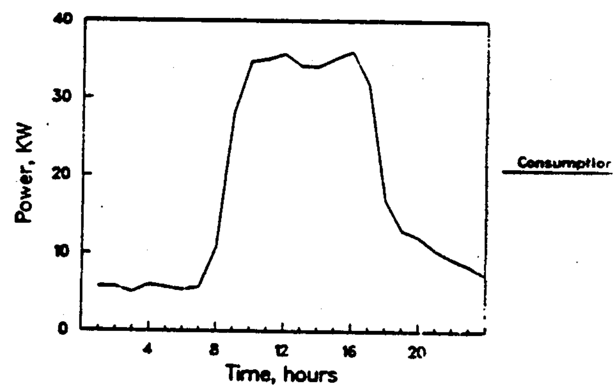
SITE 723 8/ 1/87 to 8/31/87

Average Daily Electricity End-Use Profile



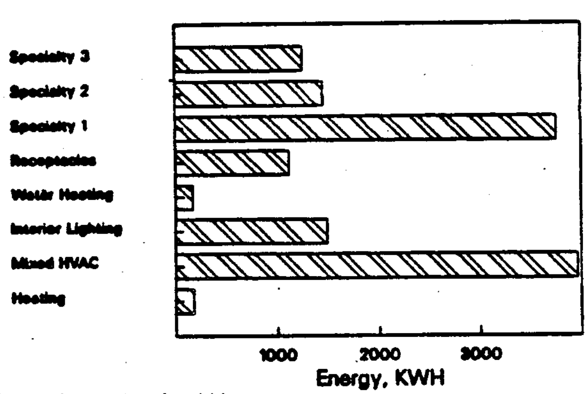
SITE 723 8/ 1/87 to 8/31/87

Average Daily Total Electricity Use



SITE 723 8/ 1/87 to 8/31/87

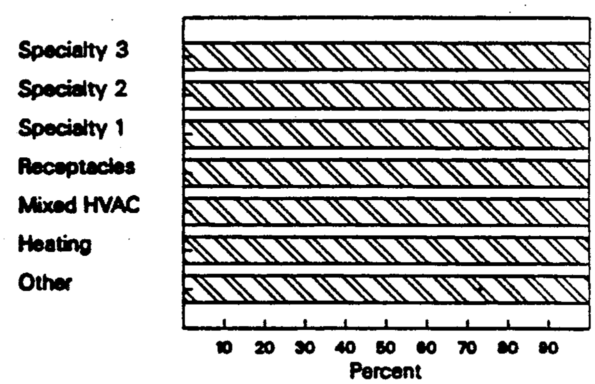
Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

SITE 723 8/ 1/87 to 8/31/87

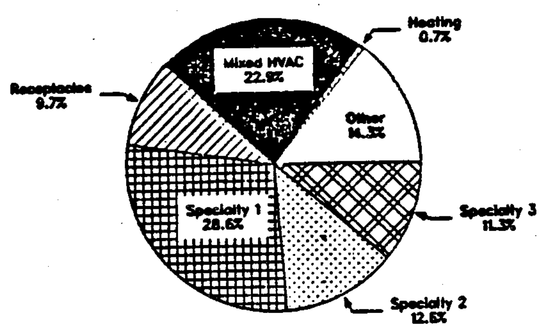
Percentage of Good Data



ELCAP

SITE 723 9/ 1/87 to 9/31/87

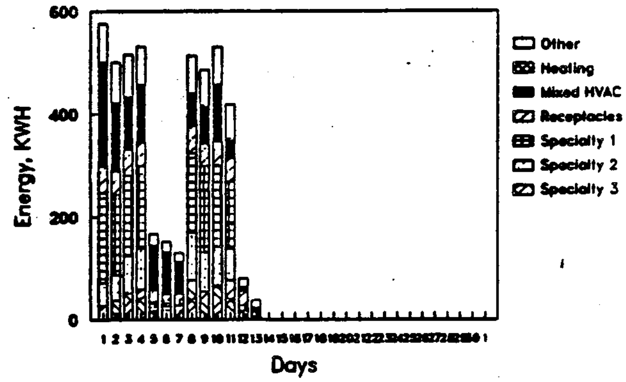
Share of Total Electricity Consumption 11,469 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

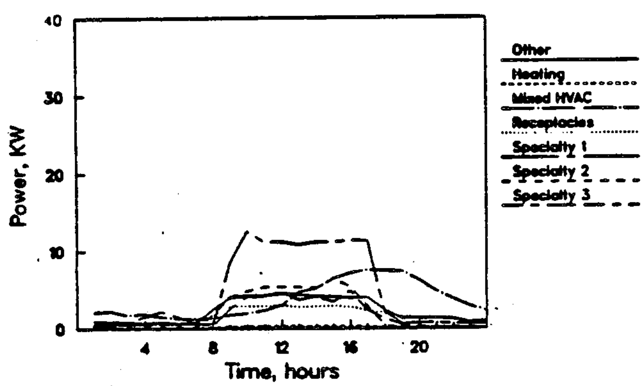
SITE 723 9/ 1/87 to 9/31/87

Total Electricity Consumption by End-Use *



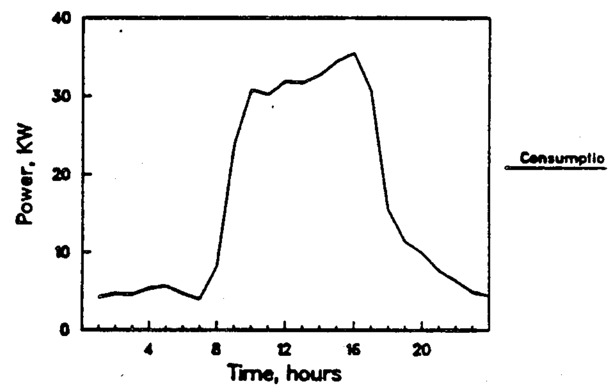
SITE 723 9/ 1/87 to 9/31/87

Average Daily Electricity End-Use Profile



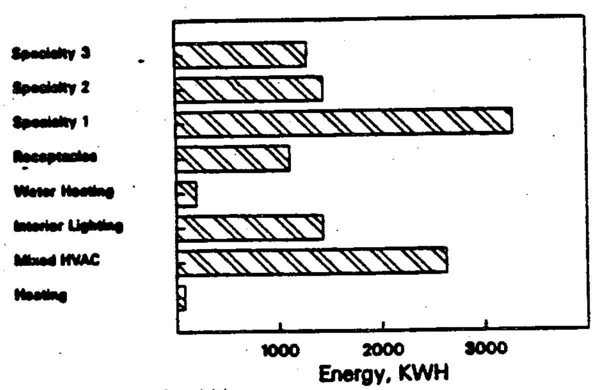
SITE 723 9/ 1/87 to 9/31/87

Average Daily Total Electricity Use



SITE 723 9/ 1/87 to 9/31/87

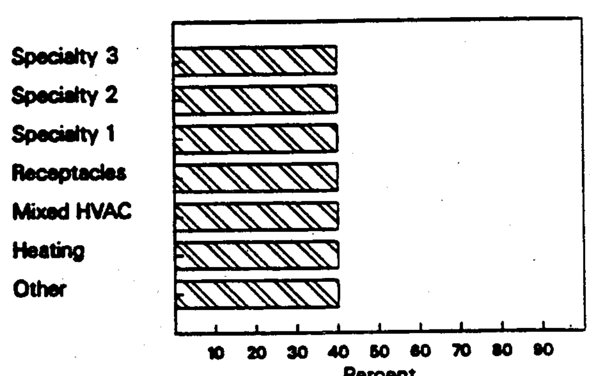
Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

SITE 723 9/ 1/87 to 9/31/87

Percentage of Good Data



ELCAP

Bldg. ID DGR102 Year Built 1977

Primary Use Bookstore Square Feet 45,966

Hours per week 54 hrs. except December - 73 hrs.

Yearly Consumption - Electrical - SCL Billing

1985 This part of the
1986 building is not
1987 individually metered.

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	concrete basement
Walls	concrete & brick R-7 insulation
Ceiling	concrete R-33 insulation
Windows	single pane metal frame
Sq. ft. windows	2205

BLDG. SYSTEMS

Heating	Hydronic, hot water from another building. Electric resistant for penthouse.
Air conditioning	Hydronic, chiller in this building.
Hot water	From other building
Refrigeration	none
Interior lights	44,420 w fluorescent 5,170 w incandescent 11,910 w Mercury Vapor 1.35w/sq.ft.
Exterior lights	2270w mercury vapor
Equipment I	Elevator
Equipment II	Book handling equipment

DGR102 is only the newer (1977) section of a building that was built several years earlier. The HVAC system is a mixture of hot water from the older part of the building and a separate chiller for this part. The wall between then has been opened up, creating a common open space. What happens in one building will effect the behavior of the other. The new part of the building with 12,584 sq. ft on 1st, 2nd & 4th floors is only slightly larger than the older section. Both have a basement level which is being used as retail space for text books. The main floor is where the office supplies, clothing & gift items are displayed and impulse buying is encouraged. The third level is a mezzanine around the sides of the building where offices are located. This also affords a good view of the main sales floor below. The fourth floor is a warehouse and bindry shop. There is a 3,894 sq.ft. penthouse on the roof.

At the back, east side of the store there is a large, open stairway and a glassed in lobby which forms the main entry to the building. A parking lot is just outside this door. There are two smaller regular store front entrances on the street side of the building. This book store is an extremely high volume business, located near a large university. All text books for the students are bought at this store. It also has a large selection of additional reference books on all subjects, popular books, fiction and nonfiction. In addition the store offers extensive office and school supplies, stationary, records & tapes, sweat shirts and other clothing (most with the university logo), and all kinds of posters, cards and gifts. All in all the store has a varied assortment of products.

Most of the year the store is open Monday through Saturday 8:45 am to 5:30 pm except open until 9 pm on Thursday. During December the store is open 9 am to 9 pm Monday through Friday, 9 am to 6 pm on Saturday and from noon to 5 pm on Sunday.

There are separate HVAC systems for the old part and the new part of the building. The system in the ELCAP metered part is hydronic heating and cooling with constant volume air, with economiser cycle. Heat is supplied by the boiler in the other building, cooling by a chiller in the penthouse of this section. There are electric resistance heaters for the penthouse.

Most of the interior lighting is fluorescent or mercury vapor. There are some incandescent lights. Exterior lights are mostly mercury vapor in the back parking lot.

AUDITOR'S OBSERVATIONS

The store has installed several mercury vapor lights which is a little unusual but does provide a clear bright interior. Most of the lights are fluorescent ceiling tubes. These could be changed to efficient fluorescents with efficient ballasts. The HVAC system has been modified to meet the needs of this new section. The chiller for this section is located in the penthouse and furnishes cold water for this section. The hot water for the hydronic systems heat comes from a boiler in the old building. The way in which the data is being collected is going to make it very difficult to obtain heating load for just this building. This is a high volume business with high internal gains. One might guess that cooling demand is greater than heating demand.

Bldg. ID DGR103

Primary Use Heavy equipment Sales & repair

Hours per week 100

Year Built 1965

Square Feet 57,432

Yearly Consumption - Electrical - SCL Billing

1985
1986
1987

Available End Use Data

July - October, 1987

BLDG. CHARACTERISTICS

Floor	concrete slab or grade
Walls	concrete - office R-7 - display R-11 - warehouse R-11 - shop 0
Ceiling	flat built up - office R-19 - display R-19 - warehouse R-11 - shop R-11
Windows	single pane, metal frames
Sq. ft. windows	901

BLDG. SYSTEMS

Heating	7 heat pumps - office & display area Radiant gas - shop Gas furnace - warehouse
Air conditioning	Heat pump - office & display
Hot water	gas
Refrigeration	--
Interior lights (At time of survey)	64,420 w fluorescent 10,670 w incandescent - 1.31w/sq. ft.
Exterior lights	--
Equipment I	welders
Equipment II	Transmission test bunch
Equipment III	Other shop equipment

DGR103 is part of a very busy, no-nonsense operation of a national company which sells parts and repairs heavy industrial equipment. The monitored building is just one of several in the complex. The three sections of this building were built at different times and have different construction components. The nominal construction date is 1965. The three sections include a sales office, a parts warehouse with a display area and a high-ceiling shop area. All areas have concrete slab or grade floors and single pane windows in metal frames.

The 14,400 sq.ft. sales office in the first section has 8 foot ceilings. The walls are concrete block, furred out, with R-7 batt insulation and finished on the inside with gypsum wall board. The flat built up roof has a 36 inch air space and a dropped, accoustical tile ceiling with R-19 fiber glass batts. The adjacent 2,755 sq.ft. display area has a 12 foot ceiling with R-19 insulation, concrete block walls with R-11 foam insulation finished with gypsum wall board on the inside. The 14,645 sq.ft. warehouse in the third section has 18 ft. average height of the sloped roof which has R-11 fiber glass batt insulation. The 24,384 sq.ft. shop area in the third section has a 26 ft. high ceiling with a built up roof with R-11 fiber glass batt. In addition there is a mezzanine level in the shop section of the building that houses the control center for the large overhead cranes and a lunch room area for the employees. The shop walls are 8 inch concrete block. The 1,536 sq.ft. of large roll up doors on both side are usually open. Insulating the walls would therefore not be practical as the doors are closed only on the coldest days, a few times in the winter.

HVAC systems are air source heat pumps with electric resistance backup in the office area. A gas furnace heats the warehouse and display area. Radiant gas heaters are used in the shop area.

When the original survey was done interior lighting was primarily fluorescent with some incandescent in the rest rooms and the lobby. During the winter of 1987-88 (November - January) the building participated in the Conservation Incentive Program through Seattle City Light. The lights were changed from fluorescent, incandescent quartz and mercury vapor in the shop area to high pressure sodium. The office fluorescents were changed to efficient fluorescent with electronic ballast. The incandescents in the lobby and the restrooms were changed to efficient fluorescent fixtures.

The office ceiling insulation was increased to R-30. The windows in the office now have double pane glazing. Nine programmable thermostats were also installed to better control the building's temperature controls.

The business operates from 6 am to midnight Monday through Friday with 135 employees working at any one time. On Saturdays it is open from 7 am to 4:30 pm with 68 employees working.

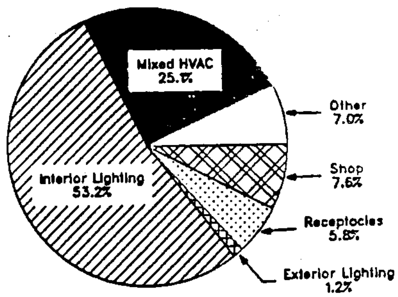
The eight arc welders with a capacity of 125,797 watts, a transmission test bench with 10,961 watts, an air compressor of 4,974 watts, cranes, garage door openers for the large doors and other equipment make up a large total connected load, but the equipment is not in continuous use. 3D graphs would dramatically show the sporadic use of this equipment. The monthly graphs tend to average it all out and present a smooth curve.

DATA

We have data from July, August, September and October 1987, just before the changes were made in the building. The lower consumption after 4:30 reflects the lower number of people working and the Saturday early closure. The graphs average the total use for all seven days of the week. The bar graphs clearly show the weekly schedule and the lack of set back on the HVAC system. The use of shop equipment and the outdoor temperature seem to have the most impact on load shape. Lights are the largest load. The data from after the retrofit should show where changes occur, hopefully in lighting load and HVAC load, as well as better control of HVAC.

SITE 591 7/ 1/87 to 7/31/87

Share of Total Electricity Consumption 84,219 KWH by End-Use *

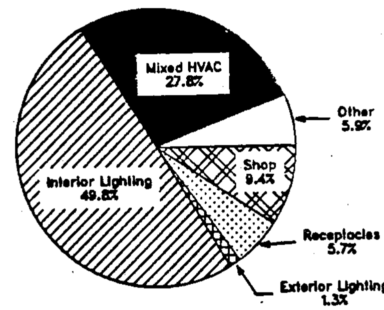


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 591 8/ 1/87 to 8/31/87

Share of Total Electricity Consumption 85,320 KWH by End-Use *

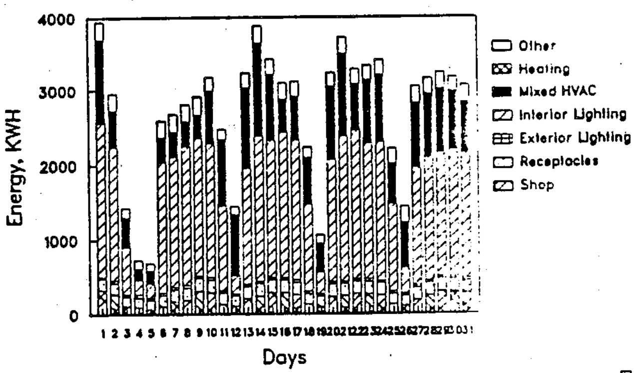


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 591 7/ 1/87 to 7/31/87

Total Electricity Consumption by End-Use *

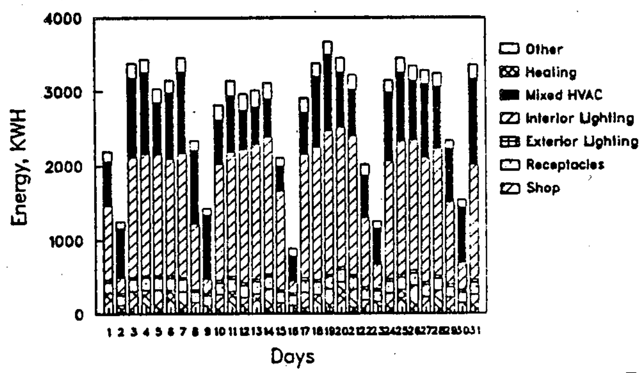


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 591 8/ 1/87 to 8/31/87

Total Electricity Consumption by End-Use *

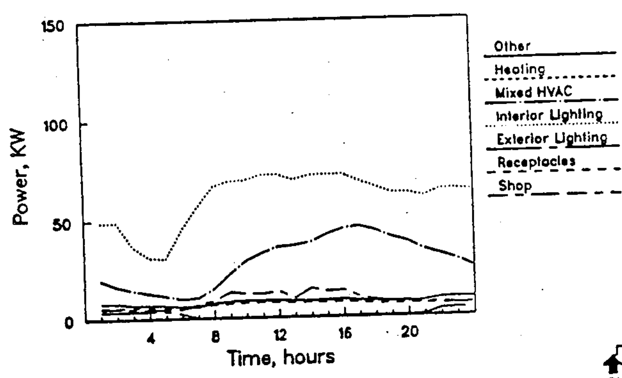


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 591 7/ 1/87 to 7/31/87

Average Daily Electricity End-Use Profile

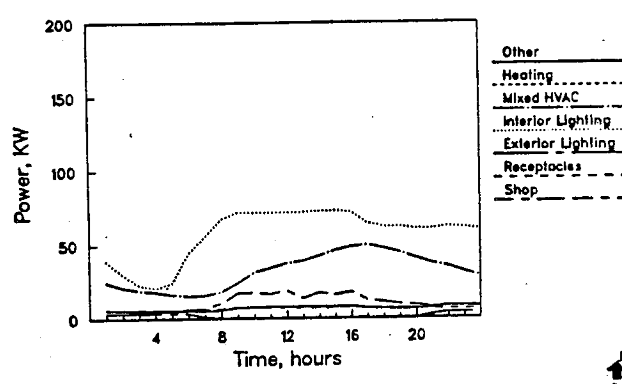


Sample size = 1

ELCAP

SITE 591 8/ 1/87 to 8/31/87

Average Daily Electricity End-Use Profile

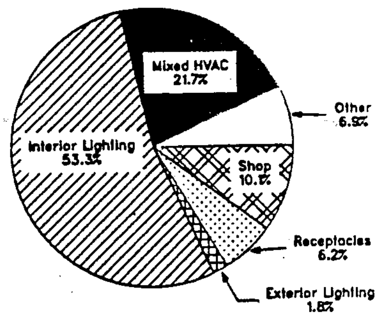


Sample size = 1

ELCAP

SITE 591 9/ 1/87 to 9/30/87

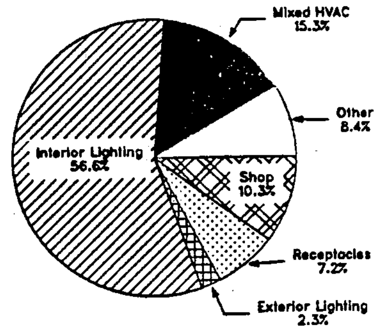
Share of Total Electricity Consumption 78,364 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 591 10/ 1/87 to 10/31/87

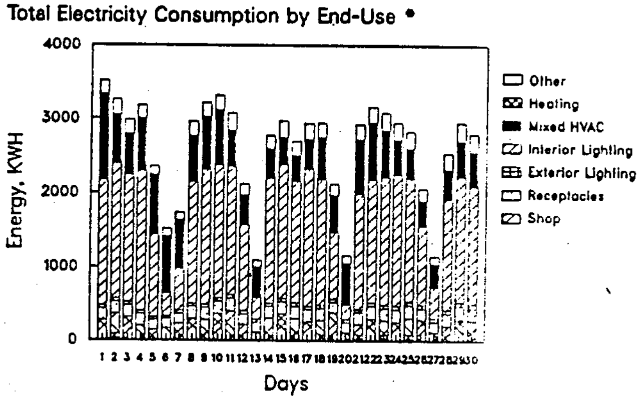
Share of Total Electricity Consumption 72,440 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 591 9/ 1/87 to 9/30/87

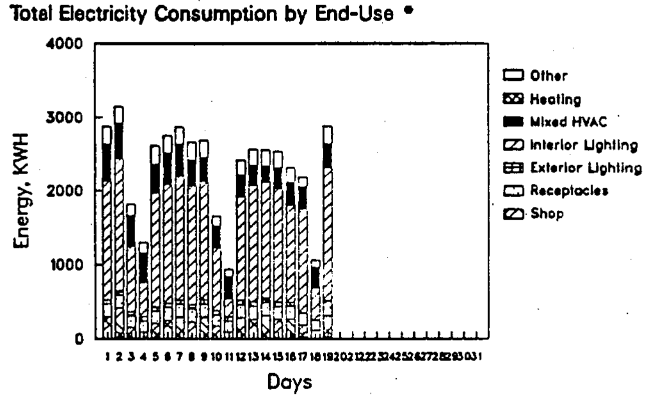
Total Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 591 10/ 1/87 to 10/31/87

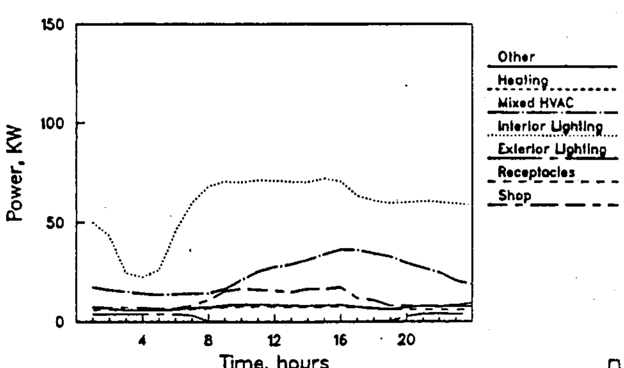
Total Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 591 9/ 1/87 to 9/30/87

Average Daily Electricity End-Use Profile



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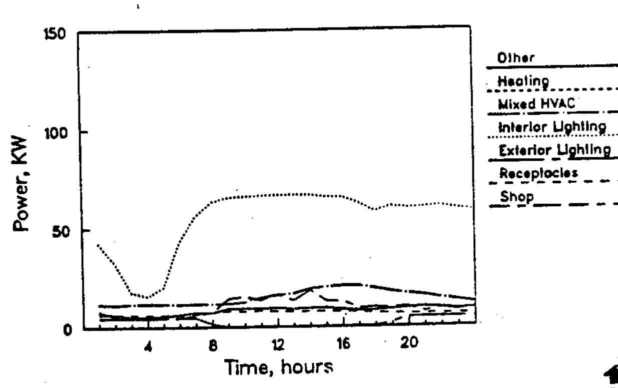
SITE 591 10/ 1/87 to 10/31/87

Average Daily Electricity End-Use Profile



Sample size = 1

Bldg. ID DGR105 | Year Built 1968
Primary Use Retail Dept. Store | Square Feet 99,480
Hours per week 80

Yearly Consumption - Electrical - SCL Billing	Available End Use Data
1985 3,045,000 - 30.6 kwh/sq.ft	NONE
1986 3,058,500 - 30.7 kwh/sq.ft	
1987 2,985,000 - 30.0 kwh/sq.ft	

BLDG. CHARACTERISTICS

Floor	concrete, slab on grade
Walls	concrete R-11 insulation
Ceiling	built up roof R-13 insulation
Windows	single pane, metal frame
Sq. ft. windows	2095

BLDG. SYSTEMS

Heating	Electric resistance forced air
Air conditioning	chiller, direct expansion for office
Hot water	electric
Refrigeration	small
Interior lights	183,860 w fluorescent 4,160 w incandescent — 1.89w/sq.ft.
Exterior lights	1050w fluorescent, timeclock.
Equipment I	kitchen equipment
Equipment II	service garage

DGR105 is a large 99,480 sq.ft. single story, concrete building housing an outlet of one of the country's largest retail department stores. It carries lower end priced goods and discounted name brand goods. It is located in a very large parking area dedicated to this one store and the grocery store which shares a common wall on the south side.

When built in 1968 it was very isolated and customers had to drive to the store. Many new, attractive apartment buildings have been built around it since the original survey was done in 1985, providing a large customer base within walking distance. The store is usually very busy. Of great concern are trouble makers and shop lifters. This aspect of management is more urgent than concerns about energy consumption.

The curved ceiling is 18 ft at the highest part forming a lighted canopy over the crowded displays of a vast variety of goods. There are some perimeter fluorescent lights in the womens' clothing section but individual spot lights or accent lighting are not used. The small restaurant section at the back has partial panels around it which cut off some of the light, giving it a dark look. The northwest corner of the building contains the automotive supply and service area. The northeast corner contains the garden supply center. A take out deli and a popcorn machine are front and center just beyond the checkout stands. The sights and smells that greet you at the front door are hallmarks of this company and are the same nation-wide.

Unlike the corporation's stores in areas of high electric rates, the northwest stores do not have an energy manager and there is no strong push for conservation. The store manager's only concern about relamping is the regular maintenance measure of replacing the 75w and 40w fluorescent tubes every two years with no thought of more efficient lighting. Interior lighting is a large load; 183,860 watts of fluorescent and 4,160 watts of incandescent. Exterior lights are 1050 watts of fluorescent tubes around the perimeter of the front entrance and the automotive entrance at the side. Other electric loads are the automotive shop equipment: compressors, wheel balancer, battery charger and brake turning machine. The restaurant has a hot dog roaster, steam tables, ice maker, freezer, refrigerator, coffee maker, dessert case, grill, deep fryer and ice cream freezer. The radio and TV department has several units plugged in and turned on during business hours.

The all electric building has electric resistance heat, a chiller for air conditioning, and for the office, a direct expansion air conditioner. Domestic hot water is also electrically heated.

The concrete building has slab on grade floor. Outside walls have R-11 insulation except across the front where there are also 2095 sq.ft. of single pane windows in metal frames, facing east.

AUDITOR'S OBSERVATIONS

The largest single load in this store would be the interior lights. More efficient fluorescents and ballasts would make an impact on the total lighting load and probably also on the air conditioning load. This store has high internal gains and the heating load is probably very small. The decrease in heat because of more efficient lighting would only be a factor on the coldest days.

Some consideration could be given to the excess heat in the kitchen. A water heater heat pump could utilized this heat to heat the domestic hot water and to supplement the air conditioning.

Bldg. ID DGR 106

Year Built 1958

Primary Use Drug-variety and Second hand retail

Square Feet 24,000

Hours per week 78

Yearly Consumption - Electrical - SCL Billing

Available End Use Data

NONE

	Drug Store		2nd Hand			
1985	142,960	+	164,700	= 307,660	12.8 kwh/sq.ft
1986	149,120	+	141,660	= 290,780	12.1 kwh/sq.ft
1987	155,840	+	151,260	= 307,100	12.8 kwh/sq.ft

BLDG. CHARACTERISTICS

Floor — concrete basement

Walls — upper level, wood frame R-11 insulation
lower level, concrete above and below grade, no insulation

Ceiling — flat built up roof, R-11 insulation

Windows — single pane, metal frames

Sq.ft. windows 612

BLDG. SYSTEMS

Heating — upper level - air to air HP electric resistance, unit gas heater.
lower level - Electric resistance

Air conditioning — upper level - air to air heat pump
lower level - direct expansion air conditioners.

Hot water — electric

Refrigeration — small load

Interior lights — 42,740 w fluorescent
420 w incandescent] 1.80w/sq.ft.

Exterior lights — Fluorescent & HID, controlled by timeclock.

Equipment I

Equipment II

DGR106 has an interesting mix of retail stores. The upper level faces south to a parking lot and houses a drug and variety store of a local chain. The lower level daylight basement contains a second hand store and faces north to another large parking lot. The 24,000 sq.ft. building was built in 1958.

The competitive drug and variety store appears well lit, with fluorescent ceiling fixtures and track spot lights for specialty displays such as cosmetics. A lot of attention is given to appearance and proper presentation of products. Walls and floors are light colored.

The second hand store is entered by going down a wide ramp just inside the low ceiling foyer which is at ground level. One definitely feels that one is in a basement. The fluorescent ceiling fixtures provide adequate, but not bright light. The fixtures have been there a long time and look it. Some are turned off in the summer as the manager attempts to keep the temperature down. Other lamps are burned out. Crowded displays and dark colors absorb much of the available light. While the store is organized into seperate departments it still has a jumbled look. The items have been cleaned up, but there is still the smell of old stuff in the store.

The wood frame building has R-11 batt insulation in the upper level walls. The lower concrete walls, both above and below grade, have no insulation. All inside walls are finished with gypsum wall board. The flat built up roof has R-11 batt insulation. The windows and entry doors are all clear, single pane in aluminum frame. On the east side of the upper level there are three insulated steel doors. There is a closed stairway from the lower level to the upper level.

The hours of operation vary somewhat but for both stores are usually from 9 or 10 am to 8 or 9 pm during the week and until 6 pm on Saturdays, Sundays and holidays. They are closed on Thanksgiving, Christmas and New Year's Day.

HVAC for the drug store consists of two air source heat pumps with electric resistance back up and also a unit gas heater. The second hand store has electric resistance heaters and three direct expansion air conditioners. Domestic hot water is heated by electricity.

There is a small refrigeration load from three soft drink coolers in the drug store and another in the second hand store.

Lights are mostly 40w or 60w fluorescent tubes in ceiling fixtures. Interestingly the lower level store has 23,420 (1.95 watts/sq.ft) of installed lights, yet appears less well lit than the drug stores which has 19,740 (1.64 watts/sq.ft) of installed lights.

Exterior lights are mercury vapor, high pressure sodium and for the signs, high output fluorescents, all controlled by time clocks.

AUDITOR'S OBSERVATIONS

Efficient fluorescents and ballasts could be used in both retail stores. The basement store could improve the light levels by replacing the yellowed plastic covers on the fluorescents and by painting the walls a lighter color. The tile floor could also be replaced with a lighter colored material.

Without the end use graphs it is difficult to suggest specific HVAC measures.

A small hot water heater or demand hot water heater would be sufficient for this business operation which has very little demand for hot water.

Bldg. ID DGR108 | Year Built 1967

Primary Use Retail-Drug and Variety | Square Feet 18,819

Hours per week 93

Yearly Consumption - Electrical

1985	357,840 -	19.0 kwhs/sq.ft.
1986	328,320 -	17.4 kwhs/sq.ft.
1987	358,920 -	19.1 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete block
Ceiling	Flat built-up roof, no insulation
Windows	Single pane, metal frames
Sq. ft. windows	624

BLDG. SYSTEMS

Heating	Forced air, gas
Air conditioning	Direct expansion air conditioners
Hot water	Gas
Refrigeration	Small Amount
Interior lights (At time of survey)	30,104w fluorescent -0- w incandescent - 1.6w/sq.ft.
Exterior lights	1500w fluorescent 750w incandescent
Equipment I	Small refrigeration load
Equipment II	Cash registers, computer

DGR108 is a 18,819 sq.ft. drug and variety store located next to an open air shopping mall. The building is free standing except 110 feet along the north wall which is connected to an office supply store.

The store was run by a large drug store chain when the monitoring equipment was first installed. Their lease was not renewed and in June 1987 another chain assumed operation of the space. Before moving in, the new proprietor painted walls and ceiling a light color and installed new lighting fixtures in the sales area. The new floors are light color composition. The feeling about the old store was that it was too dark. New fluorescent lighting was placed in the cornices which extend out and above the display shelves along the walls. This washes the displays with light as well as increases the lighting in the outer aisles. Double 8-foot bare fluorescent fixtures cover the sloped ceiling in 13 rows, creating a canopy of light. The addition of dropped, fluorescent fixtures with diffusers over the greeting card racks in the center of the store provides more light in an area where people are reading.

Ten new, small, high intensity discharge lamps (HID - MR16's) were installed in the cosmetic area at one corner of the store. Also, ten new 36-w spotlights were installed in the camera department in the other corner. Each of these areas is defined by a lowered, erector set type structure for the spotlights and the neon signs on the sides of these structures. The 14,835 sq.ft. sales area now has a lighting load of a little more than 2-w per sq.ft., up from 1.6-w per sq.ft.

No changes have been made in the storage areas, rest rooms or office. Most of the lighting is fluorescent ceiling fixtures in these spaces.

The building was constructed in 1967 and is typical of that era. The walls are uninsulated concrete block. The sloped ceiling is uninsulated built-up roof on decking. It is 16 feet from the floor in the center and 17.5 feet on one side, 14 feet on the other. There is no false ceiling and lights are attached directly to the decking. Floor is concrete slab on grade. The clear, single pane windows and glass entrance doors face west. Recent addition of raised flower beds in front create a feeling of separation between the store and the large blacktop parking lot.

HVAC systems have two ceiling mounted, gas fired, forced air furnaces, two conventional air conditioners mounted on the roof, six heat exhaust fans and two air supply vents.

Refrigeration is a small amount of total load and is included under "other." There are two soft drink display cases in the sales area, one coin operated vending machine for employees, a refrigerator in the employee break room and an undercounter refrigerator in the pharmacy.

The store has been a high volume outlet with an excellent location at the edge of a busy shopping mall surrounded by affluent neighborhoods and by a university. Hours are 8 am to 10 pm Monday through Friday, 9 am to 9 pm on Saturday and 9 am to 8 pm on Sunday. The store will be closed on Christmas and New Year's Day. When the new owner opened in June 1987, the store had up to 2,000 sales per day and by July was seeing an increase. The light level is high, which is very important in the retail business and immediately translates into higher sales. There are usually 12 to 15 employees at any one time. Vendors also come into the store to service the displays and supply their particular brands.

Data

This data is for the previous tenant. Graphs for the new tenant confirm the lighting changes in June 1987. Graphs for the month of March 1987 give a picture of a building with very consistent behavior. The pie chart #1, shows a typical load share for a retail store like this. It has large lighting and venting loads. The cooling load looks very small, but outdoor air can usually be used this time of year for the majority of cooling needed.

Graph #2, the bar graph, shows an almost identical two-week cycle.

Graph #3 shows a constant load on ventilation all month long. The interior lighting shows the pre-opening employee time and the later evening cleaning and stocking operations after the store is closed. The exterior lights come on while the other loads are at their highest level and this creates a late afternoon peak at this time of year. The summer peak may also occur at this time of day because of the cooling load rather than the exterior lights which would come on much later.

Auditor's Observations

Controlling heat gain from the large uninsulated roof and from the west facing windows are two fairly simply and probably most cost-effective measures that would be recommended. At the time of reroofing rigid foam insulation could be laid down and then the new roof applied. This would improve the building efficiency in the summer and also on cloudy days in the winter. film or other shading on the windows would decrease the day lighting at the front of the store, but with the new lights this would not cause a great impact on lighting levels. It would cut down on the solar and radiant gains from the sun and from the blacktop parking lot.

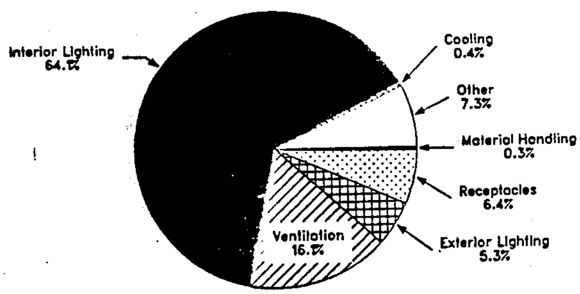
The automatic doors are opened frequently. An atrium entrance would be expensive but could provide an air lock entrance which would reduce this infiltration.

The entire HVAC system, could be changed to a more efficient heat pump system. The gas could be used for back up for those few peak periods in the winter when a great amount of heat is needed. This is a major retrofit, is expensive, but should be very efficient.

The landlord is responsible for the operation and maintenance of the present furnaces and air conditioners. A maintenance company has the contract to dot his. The new owner is observant of his energy bills. At another ELCAP building he noticed a sudden increase and then a sudden decrease in consumption. The enduse data was able to identify which circuit load was responsible; the lights in the restroom. A small space heater had been plugged into this circuit for a few months.

SITE 735 3/ 1/87 to 3/31/87

Share of Total Electricity Consumption 24,044 KWH by End-Use *

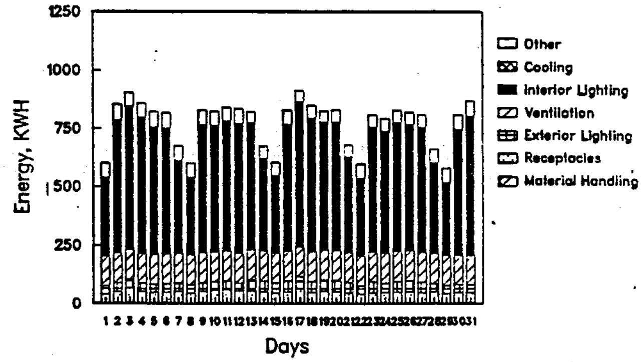


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 735 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *

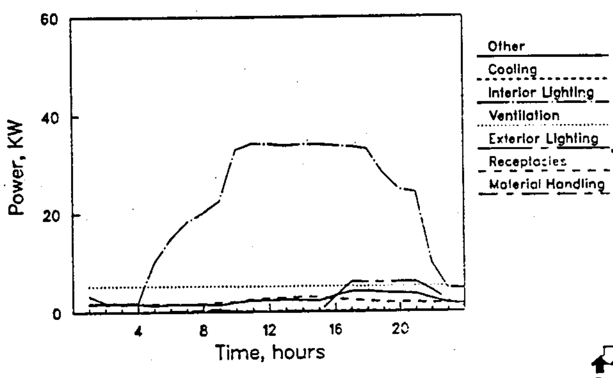


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 735 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile

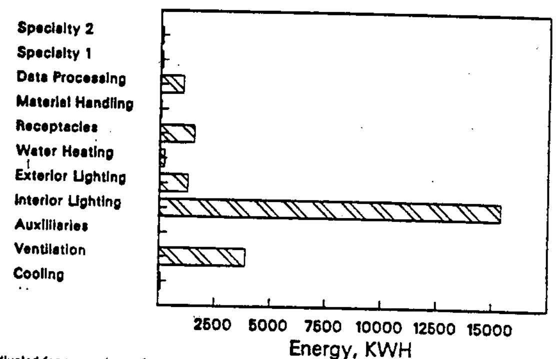


Sample size = 1

ELCAP

SITE 735 3/ 1/87 to 3/31/87

Total Consumption by End-Use *

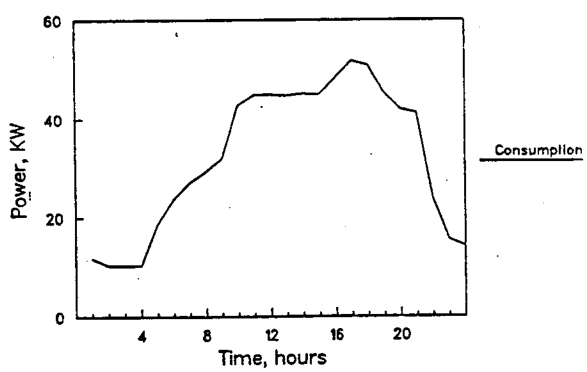


*Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 735 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



Sample size = 1

ELCAP

Bldg. ID DGR110 | Year Built 1956

Primary Use Retail Clothing | Square Feet 107,268

Hours per week 73

Yearly Consumption - Electrical - SCL Billing | Available End Use Data

1985	1,440,900	13.4 Kwhs/sq.ft	NONE
1986	1,335,600	12.5 Kwhs/sq.ft	
1987	1,422,000	13.3 Kwhs/sq.ft	

BLDG. CHARACTERISTICS

Floors	Concrete slab on grade.
Walls	Concrete, no insulation.
Ceiling	Flat roof, concrete, no insulation.
Windows	Single pane, metal frames.
Sq. ft. windows	1,262

BLDG. SYSTEMS

Heating	Gas, hot water boiler.		
Air conditioning	Central chiller & direct expansion AC		
Hot water	Gas		
Refrigeration	--		
Interior lights	60,790 w	fluorescent	
	11,570 w	Incandescent	
	33,320 w	mixed	
	105,680 w	TOTAL -	.98 w/sq.ft.
Exterior lights	4,880 w	fluorescent	
Equipment I	Elevator/escalator		
Equipment II	--		

DGR 110 at 107,268 sq.ft. is one of the larger stores of a Northwest clothing company. The square, concrete building is located at one end of an open air shopping mall. For the most part is is a free standing building with outside entrances on all four sides. About 10% of the outside wall on the first floor is attached to the other buildings in the shopping center.

There is no insulation in the walls, common for the construction year, 1956. The floor is slab on grade. The flat built up roof on concrete deck has no insulation. The dropped ceiling panels provide a meager 1.6 R value. The windows and glass entrance doors are single pane in metal frames.

The floors are arranged in a tri-level plan. The first floor covers the entire area. The second floor is half way between the first and third floors and goes around the perimeter of the building. If forms a lowered ceiling around the first floor sales area. This "mezzanine" area is completely enclosed. Offices, meeting rooms, the tailor shop and storage areas are located here.

The third floor is a sales area smaller than the first floor because of the middle level. The center of the store has one set of escalators going directly from the first level to the third level. Customers would assume the builidng has just these two levels and would probably not notice that the upper sales area is smaller than the lower sales area. The freight elevator, unlike the customer elevator, stops at all three levels. The enclosed stairwells also have access to all three levels. A penthouse at the top of the building houses the mechanical equipment, boiler and chiller.

Heat is provided by a gas fired hot water boiler, cooling by a central system chiller and for the office, direct expansion air conditioning.

Lighting was updated in 1983. Basic lights are 34 w, four foot fluorescent tubes in ceiling trouffers and 75 w incandescent spot lights in recessed cans. At the perimeter 150 w track lights and fluorescent soffit fixtures highlight special displays. In the center of the store, over the entire escalator area, there is a large, imitation sky light. Fluorescent tubes above the translucent panels provide a "daylight" effect. The survey counts 105,680 w total installed interior lights. This seems low, less than 1 watt per sq.ft. The enduse data from PNL would be valuable to check if there was an error in recording lighting load. The information has been requested.

The exterior lights are 4,440 w of fluorescent recessed fixtures on a time clock. At the time of the survey the clock was not being used. The parking area lights are metered on the mall's electric load and are not included in this survey.

AUDITOR'S OBSERVATIONS

The enduse data will be valuable in determining conservation strategies for this builidng. Interior lights are more efficient than in many buildings of this type but even here some changes can be made. Most of the incandescent lights could be changed to fluorescent or HID fixtures when the next remodel occurs. The light switching should be selective so the incandescent lights and some of the fluorescent lights can be turned off during unoccupied hours. Motion senors in storage areas and mechanical rooms could assure these lights are turned off when unoccupied.

New technologies for the chiller compressor and for the ventilation system may offer significant savings of energy.

Shell measures would be of less significance and probably not cost effective at today's energy price. At time of re-roof insulation could be added to the roof. Research on radiant barriers is being done by several organizations. This might be considred for this builidng as first findings seem to indicate savings on air conditioning when they are used in the ceiling.

Bldg. ID DGR301 Year Built 1984

Primary Use Office-warehouse Square Feet 12,096

Hours per week 45

Yearly Consumption - Electrical - SCL Billing

1985	228,480 - 18.9 kwhs/sq. ft.
1986	186,600 - 15.4 kwhs/sq. ft.
1987	179,280 - 14.8 kwhs/sq. ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade or below grade
Walls	Wood frame, stucco, R11 insulation
Ceiling	Flat built-up roof, R30 insulation
Windows	Double pane, tinted in aluminum frames
Sq. ft. windows	1,308

BLDG. SYSTEMS

Heating	Heat pumps with electric resistance back-up In warehouse electric resistance
Air conditioning	Heat pumps
Hot water	40 gallon electric
Refrigeration	--
Interior lights	20,814 w fluorescent - 1.9 w/sq.ft. 2,025 w incandescent
Exterior lights	High pressure sodium
Equipment I	Data processing
Equipment II	

DGR 301 is part of the computer age. The all-electric building was designed and built for the present occupant in 1984. The company sells and services computers and offers training in the use of their products at the facility.

It is a two story, 12,000 sq. ft., wood frame, with stucco exterior building with two square shaped sections, one north, one south. They are joined halfway down the sides. From the east side, the front, the building appears to be one story as it is built into the side of a hill.

A modern oak, grey and mauve lobby is near the center. The lobby, administrative offices and sales offices are in the 3,304 sq. ft. south section on the top floor. In the 2,744 sq. ft. north section are seminar rooms, demonstration lab. and rest rooms.

An abstract mobile is suspended from the raised portion of the ceiling over the open stairwell to the lower level. There are clerestory windows in this upper section which provide daylighting to the lobby and stairwell. The 3304 sq. ft. south section of the lower level contains a training room, an office, the employee kitchen and the service shop. The north section contains a common area and the 2,377 sq. ft. warehouse. The loading dock is at the back on the west side of the building.

The above grade walls have R11 insulation. Below grade walls are concrete with R6 insulation. A flat built-up roof with R30 insulation covers both sections of the building. In the warehouse the insulation is an exposed vinyl backed batt. In the office it is covered by a gypsum wallboard ceiling.

Windows are all double pane, tinted glass in metal frames. About one-forth of the wall area of the upper floors is window. The lower level is partially below grade and contains the warehouse. Windows are a minor area of the walls on this level.

HVAC in the office areas is supplied by eight heat pumps with indoor and outdoor air flows and auxiliary resistance heat. The lobby area is a small area which has an open stairwell, a raised ceiling, the main outside door and many windows, all of which create air currents. Because this made it feel cool, an electric wall heater was installed near the reception desk. The warehouse has electric resistance heat.

Interior artificial lighting is fluorescent ceiling fixtures. The reception area has twelve 150w incandescent spotlights. The front windows and clerestory window provide day lighting.

The building has the usual kitchen equipment, restroom lights and fans. A significant load is the computers and their related equipment. One monitoring channel has outlets with data equipment, work stations and some small kitchen equipment. The other channels are monitoring single end uses, such as interior lights, work stations, HVAC.

The company has about thirty regular employees. Customers come into the building infrequently except for the training classes. Up to forty people can be attending class at one time. The classes are usually scheduled for regular business hours. Occasionally there may be some evening or weekend activity.

Data

March 1987 data in Graph #1 shows a typical end use share for a well-insulated office building with many computers in the building. It is heated with eight heat pumps. Some of the HVAC during the day is probably for cooling. Billing data for other times of the year show that consumption is higher in summer and the very highest in winter, (when it would be necessary to use the back-up heat.) Lighting has the largest share of consumption and contributes heat to the internal spaces.

Graph #2 shows heat on during the weekends when no one is there. A 3D graph would show exactly when heat is on. It appears that there is a set back for the HVAC system but not for the electric baseboard heat in the reception area and in warehouse. In Graph #3 heat appears to be on all the time at this time of year.

The noticeable load on Graph #3 is the HVAC, which peaks about 5 a.m., long before any employees arrive. It drops immediately when the people come in and turn on lights and other equipment.

Auditor's Observations and Recommendations:

1. The incandescent lighting in the reception area could be changed to fluorescent spot lights. Light levels and appearance would be maintained at about 25 percent of the present load in this area.

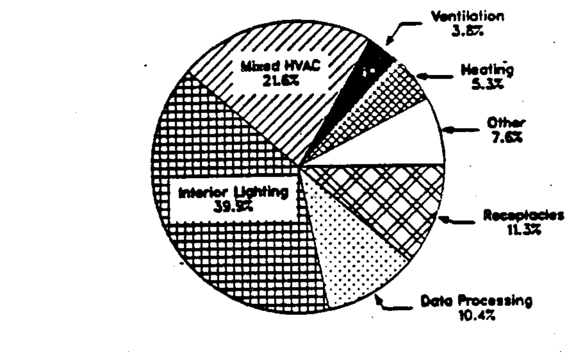
2. Tinted glass on windows cuts solar gains; desirable in warm weather, but not in cold. It is a trade off. Window curtains or shades would give the occupants more control.

3. Better control of the HVAC system, perhaps starting it an hour earlier, but at a lower temperature. This would warm the building slowly and avoid the sudden spike in HVAC load. Economisers with enthalpy controls can cut HVAC load year around. The electric resistance heaters should be set as low as possible during unoccupied hours.

4. The building is only used five days a week during daytime hours. Therefore no shell measurements would be recommended.

SITE 293 3/ 1/87 to 3/31/87

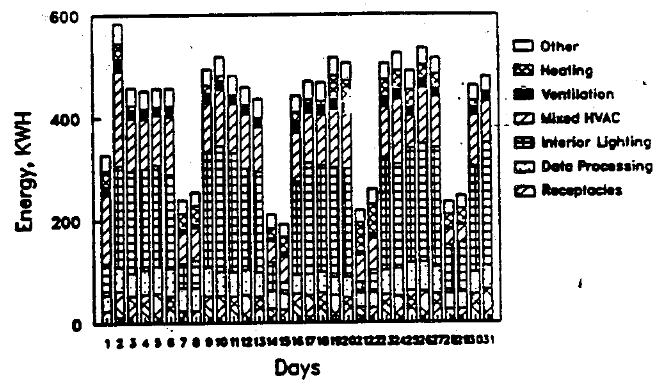
Share of Total Electricity Consumption 12,889 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

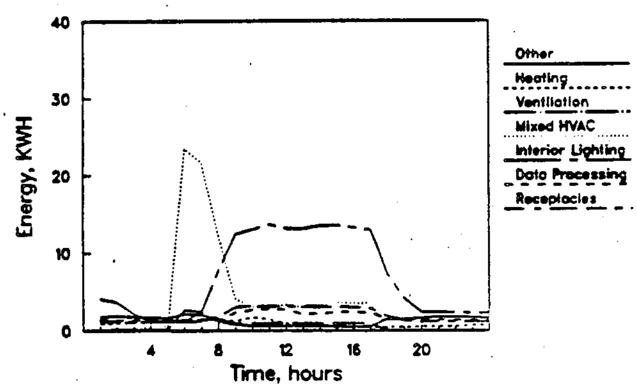
SITE 293 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



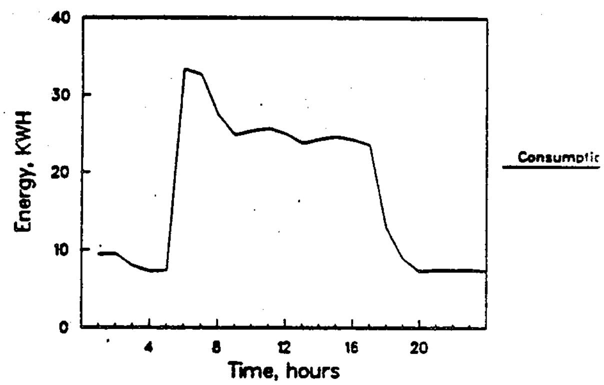
SITE 293 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



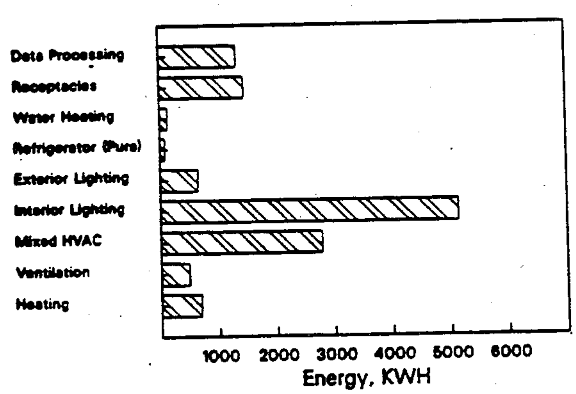
SITE 293 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 293 3/ 1/87 to 3/31/87

Total Consumption by End-Use *

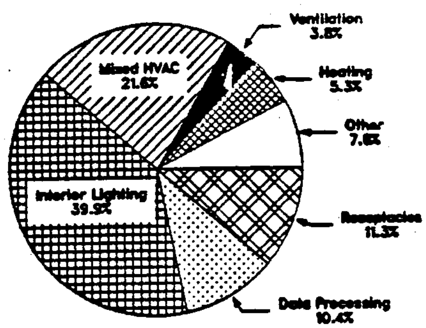


*Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 293 3/ 1/87 to 3/31/87

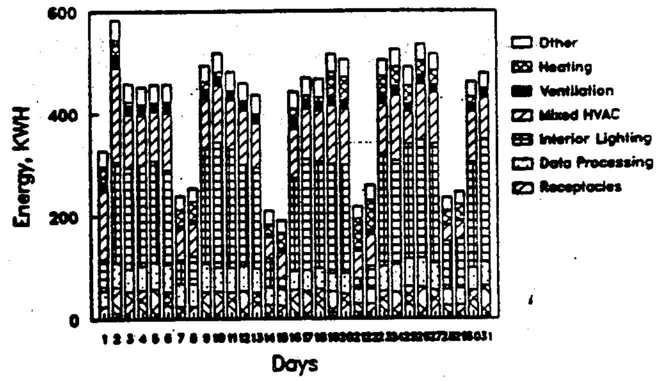
Share of Total Electricity Consumption 12,889 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

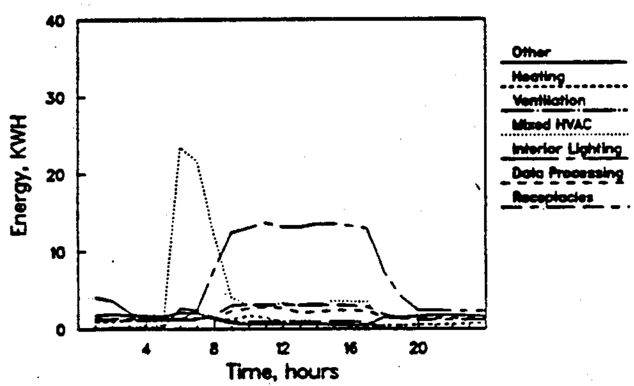
SITE 293 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



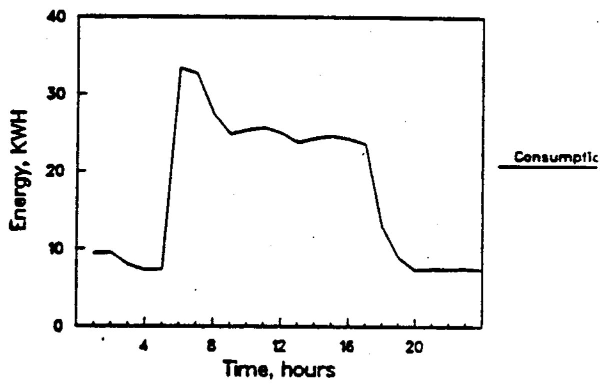
SITE 293 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



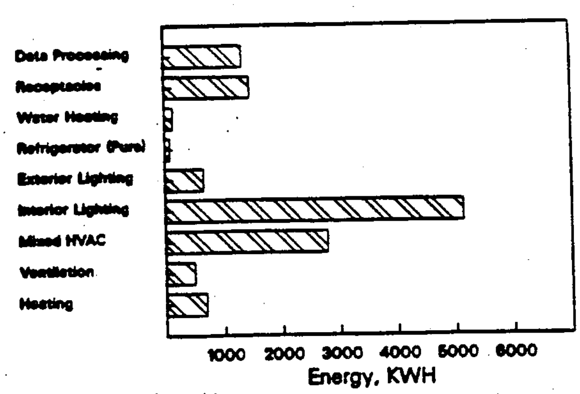
SITE 293 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 293 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID DGR302

Year Built 1982

Primary Use Lease/Sales Heavy Equipment

Square Feet 2292 offices
2590 warehouse
4882 TOTAL

Hours per week 50

Yearly Consumption - Electrical

1985 56,960 - 11.67 kwhs/sq.ft.
1986 50,080 - 10.26 kwhs/sq.ft.
1987 59,040 - 12.09 kwhs/sq.ft.

Available Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Offices - wood siding, R-11 insulation. Warehouse - 6 inch concrete, no insulation.
Ceiling	Offices - Flat, built up roof with R-19 insulation. Warehouse - Flat built up roof, no insulation.
Windows	Double pane with metal frames, all located offices.
Sq. ft. windows	330

BLDG. SYSTEMS

Heating	Electric baseboards
Air conditioning	Window air conditioners
Hot water	Electric water heater
Refrigeration	--
Interior lights	Office - 3,980 w fluorescent 1.74 w/sq.ft. Warehouse - 2,100 w fluorescent .81 w/sq.ft
Exterior lights	400 w Mercury vapor > on photo cell 780 w incandescent >
Equipment I	Heavy machinery - welder, drill press, compressor, battery charger, etc.
Equipment II	Office equipment

Bldg. ID DGR 305

Year Built 1983

Primary Use Retail

Square Feet 3,265 heated
1,240 unheated
4,505 TOTAL

Hours per week 55

Yearly Consumption - Electrical - SCL Billing

1985	24,985 - 5.5 overall	7.7 heated	
1986	22,926 - 5.1 overall	7.0 heated	
1987	18,491 - 4.1 overall	5.7 heated	

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	concrete slab on grad.
Walls	wood frame R-11 insulation.
Ceiling	flat roof R-20 insulation.
Windows	Double pane in wide metal frame.
Sq. ft. windows	4,430

BLDG. SYSTEMS

Heating	Air to air heat pump, electric resistance backup.
Air conditioning	Air to air heat pump.
Hot water	Electric
Refrigeration	--
Interior lights	6,368 w fluorescent 1,476 w incandescent - 1.74 w/sq.ft.
Exterior lights	incandescent
Equipment I	Battery charger
Equipment II	--

DGR305 is a modern, two story, wood frame building constructed in 1983. The tenants in the building are a 950 sq.ft. custom home furnishing store and their 1,240 sq.ft warehouse space on the first floor. A 590 sq.ft. real estate office and a 1,589 sq.ft. audio video rental-sales office occupy the second floor. The real estate office became vacant in November, 1987. However, it is on the same HVAC system as the larger audio-video store so heating and cooling are dictated by that occupant and the space continues to be conditioned.

The building is tucked into a small, incongruous, industrial and residential area between the freeway and the Duwamish Waterway. It is an attractive, achitectural designed building with residential type windows, an upper outside deck and landscaped yard. It presents a homey appearance with the cocker spaniel snoozing in the sun on the driveway.

The entry is at the west end of the building, next to a small parking lot. The second floor extends over the entry, providing a sheltered entry to the first floor show room. A large warehouse door faces the street on the south side.

All of the 443 sq.ft. of clear double pane windows in heated spaces face west or south. The windows in the furniture show room are in wood frames, the others are in metal frames. The exterior doors to the 1st floor show room and to the 2nd floor deck are wood with double pane glass, "store front" doors.

The outside walls and the wall between conditioned and unconditioned space have R-11 insulation as does the ceiling above the unconditioned warehouse. While there is no visible insulation in the flat roof, building code required R-20 or more at the time it was built. The survey indicates no insulation , but I would guess there is rigid foam on top of the plywood deck. There should also be insulation in the floor above the entry and in the floor of the deck which is part of the ceiling of the show room below. The floor is concrete slab on grade.

HVAC system has a heat pump with electric resistance duct heaters for each floor. The system is constant volume.

The building originally had several problems with the heat pumps. Up until 1987 both heating and cooling were going on at the same time. The tenants say that since the first of 1987 they have worked satisfactorily. One wonders if the 20% drop in consumption in 1987 is partly due to this.

Hot water is provided by a residential type hot water heater. The lights in the show rooms, offices and warehouse are fluorescent tube ceiling fixtures. In the stairwell and rest rooms lights are incandescent. Exterior lights are incandescent.

AUDITOR'S OBSERVATIONS

Some lighting modifications could be made. Particularly the incandescent interior and exterior lights could be changed to fluorescent. Efficient ballasts and bulbs could be considered if the fluorescent lighting is being changed in the future. The hot water could be heated by point of use heaters or small under counter tanks. The building consumes a very small amount of electricity so any conservation measures would have a very long payback period.

Bldg. ID GR0002

Year Built 1965

Primary Use Retail Fish Market

Square Feet 7,552

Hours per week 63

Yearly Consumption - Electrical - SCL Billing

1985 286,880 - 38.0 kwhs/sq.ft.
1986 291,200 - 38.6 kwhs/sq.ft.
1987 295,680 - 39.2 kwhs/sq.ft.

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete basement
Walls	Concrete, no insulation
Ceiling	Flat, built-up roof, no insulation
Windows	Single pane, wood frame
Sq. ft. windows	592

BLDG. SYSTEMS

Heating	Air-to-air HP, electric resistance backup
Air conditioning	Air-to-air HP
Hot water	Gas
Refrigeration	< 45,600 w
Interior lights	5,680 w fluorescent 8,980 w incandescent - 1.94 w/sq.ft.
Exterior lights	Time clock - 1,050 w, fluorescent, HID & incandescent
Equipment I	Food preparation
Equipment II	--

GR0002, built in 1965, is a rather unusual grocery store as the main products sold are seafood and related items. It is located away from the waterfront area on a main throughway just south of the city center. One can browse through the ordinary and the not so ordinary seafoods. There are piles of fresh fish and shellfish on tables filled with ice, refrigerated cases with completely dressed fish, shelled shellfish and other prepared fish delicacies. There is a lot of talk back and forth in Asian languages and in English among the many employees as they work, stacking the fish, dressing it, preparing the other items or serving the customers. Melting ice makes rubber boots a desirable item of apparel. There is an appearance of chaos, but the special orders are ready when customers arrive for them.

The building is 3,776 square feet on each floor. It is a long, narrow, concrete, uninsulated structure with a concrete basement. It has a flat, built-up roof on wood decking, no insulation. The single pane, aluminum frame window areas face east and north from the salesroom. The parking lot runs along the long north side. The entrance is toward the front of the building on this side.

The retail store, office, prep room, kitchen, unloading area and walk-in refrigeration storage are on the street level.

The HVAC system has two heat pumps for heating and cooling with back-up electric resistance heat coil, two heat rejection fans and two circulation fans.

The majority of lights on the main level are fluorescent ceiling fixtures. There are several incandescent flood and spot lights behind the counter and for displays in the retail area. The basement storage and walk-in freezer and refrigerator have incandescent bulbs.

Some electric food preparation equipment is used: mixer, grinder, fish cake press, clam farm, rice steamer, wrapping machine. The fish smoker has an electric exhaust fan.

The basement, reached by inside stairway or by freight elevator, contains open unconditioned storage space, a 1,064 sq.ft. walk-in freezer, and restrooms.

The big load for this store is refrigeration and freezing. There is a large walk-in freezer, two regular freezers, two ice machines, a large walk-in refrigerator, frozen food cases, refrigerated cases and smaller coolers. The gross electric consumption is a little higher in the summer than in winter and is lowest during our mild spring or fall weather. This reflects the large refrigeration load in the summer and the larger heating load in the winter.

DATA

The monthly data clearly shows refrigeration as the major load, with little variation except for holidays and Sundays when the store is closed. It then drops slightly but must be keep on 24 hours a day to preserve the food.

The daily hourly end-use graphs are very straightforward. The refrigeration cycles on more during operating hours and at the end of the day when the seafood is put away for the night. HVAC shows a very slight increase at the start of the business day. The other load reflects activity throughout the day. Interior lights are picture perfect for business hours.

AUDITOR'S OBSERVATIONS

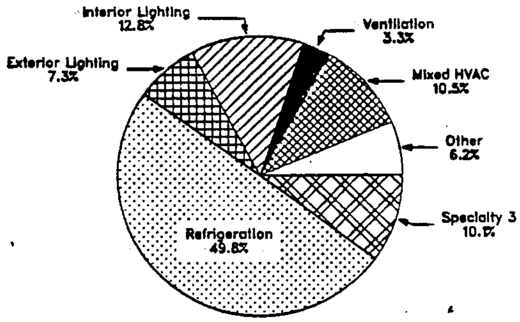
A simple strategy would be to change the incandescent bulbs in basement storage area to fluorescent and the incandescent spot and flood lights to fluorescent or HID spot and flood lights. This would decrease the lighting load.

Another measure to be considered would be rigid insulation on top of the roof. It could be applied directly and a new roof installed over it. This should be done when a new roof is needed. Exterior wall insulation is a more expansive measure, but would make a difference. Shading the windows in summer time would also decrease the heat gain from the black top parking lot.

The whole HVAC and refrigeration systems could be integrated and made as efficient as possible. Waste heat from refrigeration could be used for DHW and for winter space heat. This would be a major renovation and costs would be high. Because refrigeration is the large electric load, conservation opportunities in this area could afford greater savings than in other areas. Examples would be efficient compressors, strip curtains for open doors, better insulation.

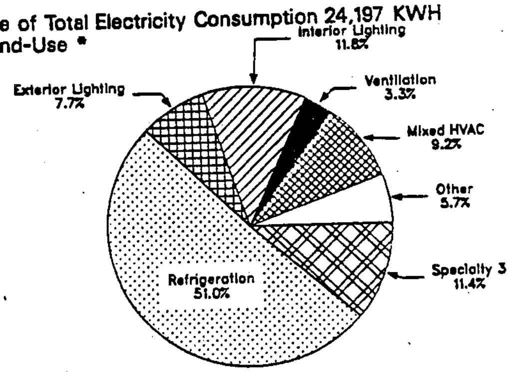
SITE 597 12/ 1/87 to 12/31/87

Share of Total Electricity Consumption 25,364 KWH by End-Use *



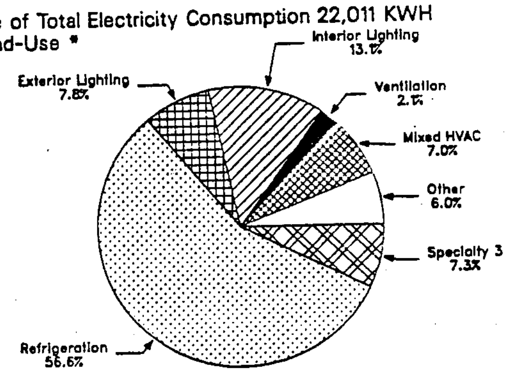
SITE 597 1/ 1/88 to 1/31/88

Share of Total Electricity Consumption 24,197 KWH by End-Use *



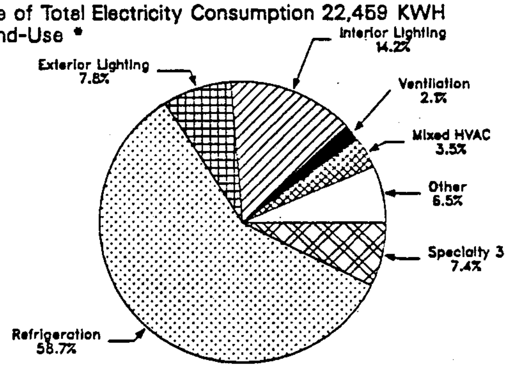
SITE 597 2/ 1/88 to 2/29/88

Share of Total Electricity Consumption 22,011 KWH by End-Use *



SITE 597 3/ 1/88 to 3/31/88

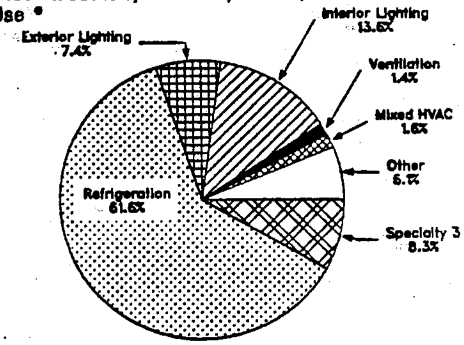
Share of Total Electricity Consumption 22,459 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

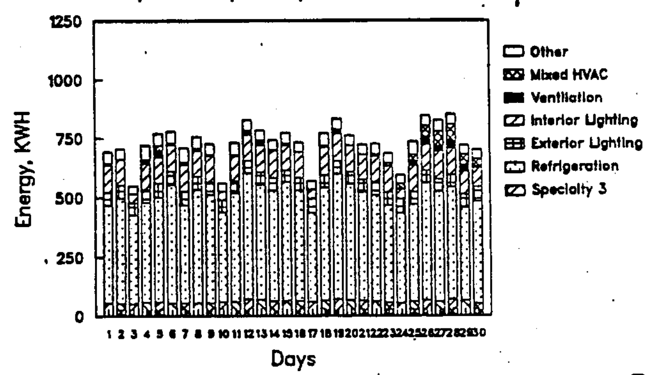
SITE 597 4/ 1/88 to 4/30/88

Share of Total Electricity Consumption 21,901 KWH by End-Use *



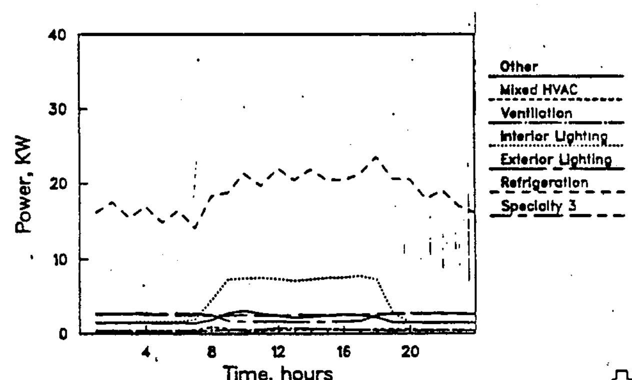
SITE 597 4/ 1/88 to 4/30/88

Total Electricity Consumption by End-Use *



SITE 597 4/ 1/88 to 4/30/88

Average Daily Electricity End-Use Profile



Sample size = 1

Bldg. ID	GRO 003	Year Built	1964
Primary Use	Convenience Grocery	Square Feet	1616
Hours per week	168		

Yearly Consumption - Electrical - SCL Billing

1985 - 208,666 - 129.1 kwhs/sq.ft.
1986 - 239,245 - 148.1 kwhs/sq.ft.
1987 - 256,338 - 158.6 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Steel panels, R-11 insulation
Ceiling	Dropped ceiling, R-19 insulation
Windows	Single pane in metal frame
Sq. ft. windows	162

BLDG. SYSTEMS

Heating	Air-to-air heat pump, electric resistance back up
Air conditioning	Heat pump
Hot water	Electric
Refrigeration	Central system + 2 self contained units
Interior lights	3390, fluorescent > 2.1w/sq.ft.
Exterior lights	6090w fluorescent 800w Mercury vapor
Equipment I	Food prep.
Equipment II	

GR0003, built in 1964, is one of the new breed of marketing animal: a 1,616 square foot gas station turned franchise grocery store in 1981. The mini-mart specializes in convenience food, necessities, fast food, cigarettes, beer and also gasoline. There have been few changes since it was converted in 1981. In March 1986 the parent company resumed management and a new manager was hired. It continues to bear the name of the petroleum company that owns and manages the store. Only a small amount of equipment was added, two soup warmers, which are on 24 hours a day and a toaster which is used occasionally. However, the electric consumption increased dramatically (see consumption history). This is probably due to the absence of an owner/manager.

There are four gasoline pumps facing the north and four facing the west streets which meet at this corner. The 162 sq.ft. of window across the front of the store on the north and on the west, are single pane, clear glass in aluminum frames. There are no window coverings. Sixty-five percent of the wall area is steel siding inside and out, with R-11 insulation. Twenty-five percent, across the back of the store and the restroom, are plain concrete block. Ten percent, under the windows, has decorative brick veneer on steel siding with wallboard on the inside. The floor is concrete, slab on grade. The flat built-up roof has no insulation, but the suspended ceiling, three feet below, has R-19 batt insulation laying on the ceiling panels. In the office/work area the ceiling panels and the insulation have been moved over by workmen to gain access to the area. The insulation and panels have not been replaced, leaving a 4 x 4 foot opening in the ceiling.

Refrigerated cases and walk-in cooler are served by a central compressor, installed in 1981.

The HVAC system is an air source heat pump with heat rejection fan and circulation fan. On the day of the visit it was 75° and the door was propped open to get more air into the store.

Interior lighting is all fluorescent fixtures, 8 ft., 75w tubes and 4 Ft., 40w tubes, on 24 hours a day. Exterior lighting is mercury vapor 400w lamps and 75w fluorescent tubes. There is no automatic control.

The store is open 24 hours a day all year. There are usually two employees, occasionally three. One or two customers are in the store at any time, but there have been as many as seventeen. Most of the business consists of quick one or two item purchases or payment for gas from the self service islands outside.

The sales area is arranged so the front counter and cash register project out to the center, fairly close to the front door. The cashier can see out the windows in both directions to see the gasoline pumps. A workroom is behind the counter. Basic food preparation is done here and passed through to the main service area. Two soup warmers are on the counter here. The refrigerated cases line the back, south wall and there is a large freezer on the east wall. The restroom is at the southeast corner of the building, reached by an outside door. The 257 sq.ft. built-in refrigerated storage room runs across the back of the building. The small office is between the restroom and the workroom.

Data:

The data for March 1987 is for a time after the store reverted back to the parent company. On graph #1 the load percentages are fairly typical of a small convenience grocery/gas station business except for the exterior lighting load, which is high. On graph #2 we see that the exterior lighting is the most erratic load and is the one factor that changes daily consumption levels. On graph #3 we see the exterior lights are on during the day. This is probably because the person working that day forgets to turn off the exterior lights.

The mixed HVAC load shows a demand for cooling as the day warms up. If the demand was for heat it should show up at night as this store is open 24 hours a day. Interior lighting is a flat constant load. Refrigeration shows consistent cycling of the equipment.

Graph #4, average total consumption by hour, shows the same slope as the exterior lighting load, since it is a sizable load and the only one that varies much.

Auditor's Observations and Recommendations:

1. Operation and maintenance items need to be addressed. The large hole in the ceiling has been there for months. Moving the ceiling panels and the batt insulation back into place would solve this. There has been frequent turnover in managers, e.g., two in the last month.

2. The HVAC system is not meeting the needs of the building. Does it need better maintenance, better controls or replacement? Replacing the seven year old system to a new efficient system might be a good investment.

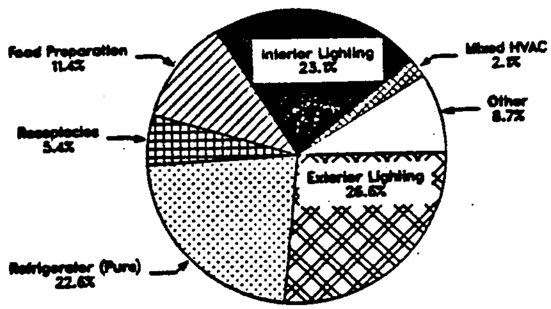
3. The interior and exterior fluorescent lighting could be upgraded to fixtures with electronic ballasts and more efficient tubes, 32w and 60w vs. the present 40w and 75w tubes. Since the interior lights are on 24 hours a day the return on investment would be rapid.

4. The outdoor mercury vapor lights could be changed to high pressure sodium lights with photo cell control. These would be over twice as efficient and maintain their lumen output longer. The color would be pink which may or may not be of concern to the operators of the store. The photo cell would free the operation from dependence on the ever-changing staff.

5. The building is used 24 hours a day, therefore shell measures should be looked at. However, the door is opened so frequently the shell measures lose some of their impact. The single pane windows could be changed to double. More insulation could be added to the ceiling. The uninsulated concrete wall is along the well insulated walk-in cooler and the restroom, therefore insulating this wall would not be recommended.

SITE 587 3/ 1/87 to 3/31/87

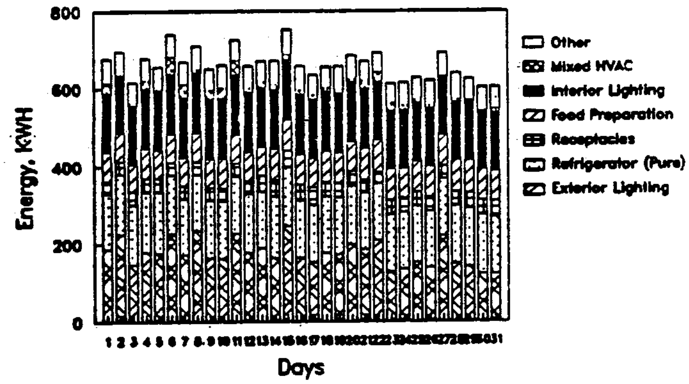
Share of Total Electricity Consumption 20,540 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

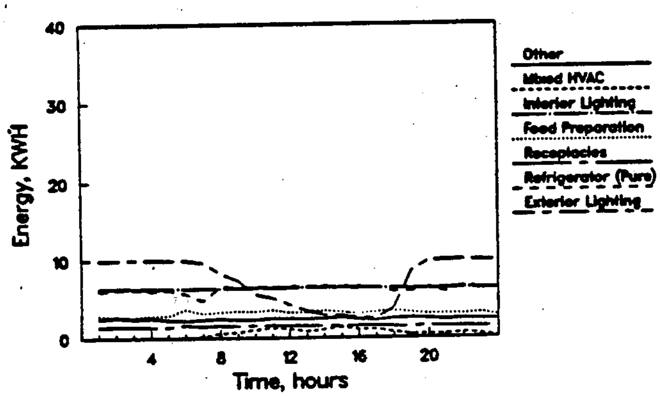
SITE 587 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



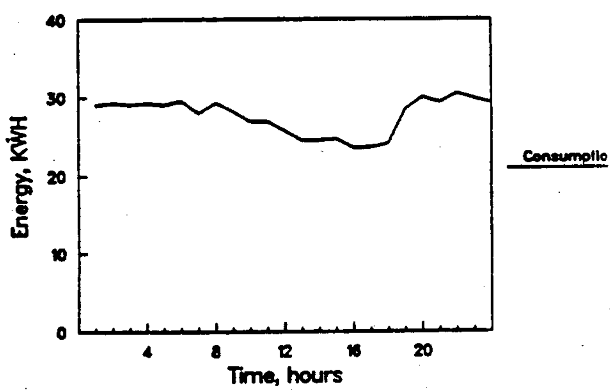
SITE 587 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



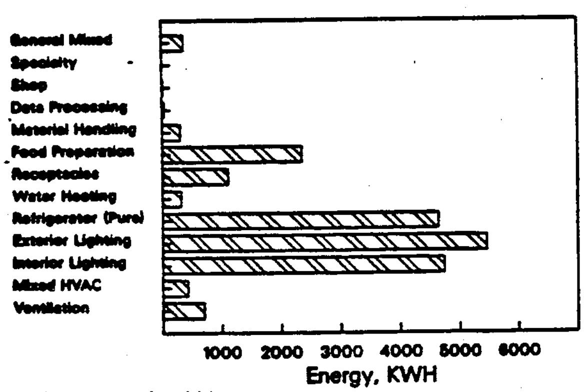
SITE 587 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 587 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID GR0004 Year Built 1971

Primary Use Ice Cream Store Square Feet 1,072

Hours per week winter 79, summer 88

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985 - 81,861 kwhs - 76.3 kwhs/sq.ft. March 1987
1986 - 96,892 kwhs - 90.4 kwhs/sq.ft.
1987 - 91,771 kwhs - 85.6 kwhs/sq.ft.

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete block
Ceiling	Flat built-up roof, R-20 insulation
Windows	Single pane in metal frame
Sq. ft. windows	470 square feet

BLDG. SYSTEMS

Heating	Air-to-air heat pump, electric resistance backup
Air conditioning	Air-to-air heat pump
Hot water	30 gallon electric
Refrigeration	Central system + 4 small freezers
Interior lights	1,270 w fluorescent - 1.2 w/sq.ft.
Exterior lights	2,450 w fluorescent
Equipment I	--
Equipment II	--

GR0004 sells a very limited line of food, but in a wide variety of flavors. The building is a copy of all the other ice cream stores built in 1971 by this chain: a long narrow 1,072 square foot building with the ice cream display case running the length of the customer area. A "party case" freezer which has the specialty items and individual orders displayed is at the back end of the room.

Most of the year the store is open from 11 a.m. to 10 p.m. Sunday through Thursday, 11 am to 11 pm Friday and Saturday. June through August it is open 10 am to 11 pm Sunday through Thursday, and 10 am to midnight Friday and Saturday.

The small appliances for the soda fountain and a small refrigerator are on the work counter along the wall in back of the freezer cases. Seating is a single row of "desk chairs" on the wall opposite the freezer cases. The small back room contains a chest freezer, an upright freezer, a sink and a large walk-in freezer. There is a small rest room next to the back exit door.

The long west wall and the north wall in the sales area are primarily single pane windows in aluminum frames. The other walls are concrete block, The building has a flat built up roof with R-20 batt insulation.

Domestic hot water is provided by a 30 gallon electric water heater. Interior and exterior lights are fluorescent tubes. Outside lights are controlled by a time clock. Inside lights have manual controls.

Refrigeration/freezing is a large load in this building both summer and winter, with a 12,400w capacity. Air conditioning and heat are provided by a heat pump with auxilliary electric resistance heat in the duct.

Loads are discreet. Each end use is on a separate channel of the monitoring system.

The windows face west to the parking lot. The neighborhood has heavy foot traffic as well as motor vehicles on the street. A community college and busy shopping area help supply customers to the store.

Data:

March 1987 data makes it somewhat difficult to determine if the HVAC is for heating or cooling. It appears to be on day and night, rather consistently. Given the pattern with the slight dip about 1 p.m., it is probably heating.

The refrigeration load consumes the most energy and is a very consistent daily load. The water heater and the mixed HVAC are the loads with the greatest daily variation. The exterior lights, which are supposed to operate on a time clock also vary widely. Is the time clock really being used?

Auditor's Observations and Recommendations:

The design and operation of the store could be changed.

1. There would be no reason to heat the store at night.

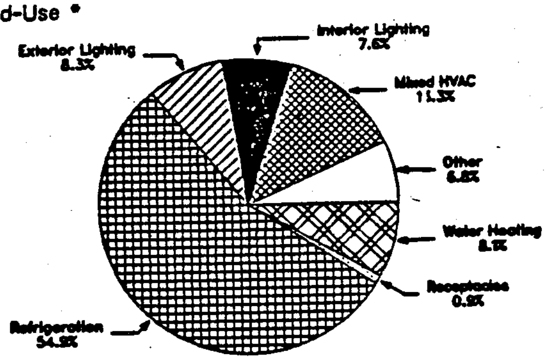
2. The building has no overhang, shading, or window covers to protect it from the west sun and the radiant heat from the blacktop parking lot. The single pane windows make up 66 percent of the walls in the sales area. Tinted double pane glass, interior storm windows, tinted clear plastic shades and/or awnings would increase the R value and/or decrease the solar gain.

3. The two glass doors at opposite ends of the sales area allow unconditioned air to flow freely into the store when both are opened. Two sets of doors, forming an air lock entry, would decrease this infiltration. In summer the store is busiest at the warmest times of the day.

4. A heat recovery system for the freezer compressor could help heat the store in winter with the waste heat and also to heat the domestic hot water year around.

SITE 690 3/ 1/87 to 3/31/87

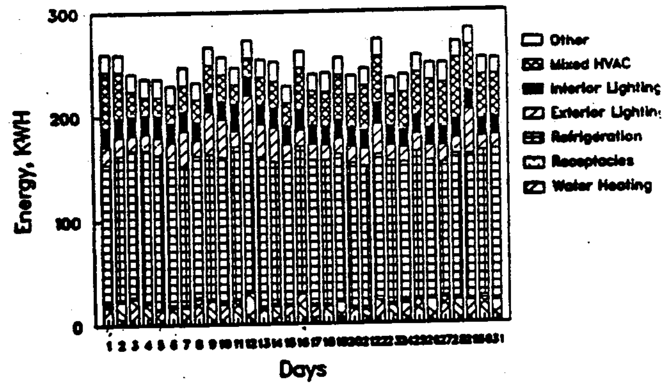
Share of Total Electricity Consumption 7,763 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

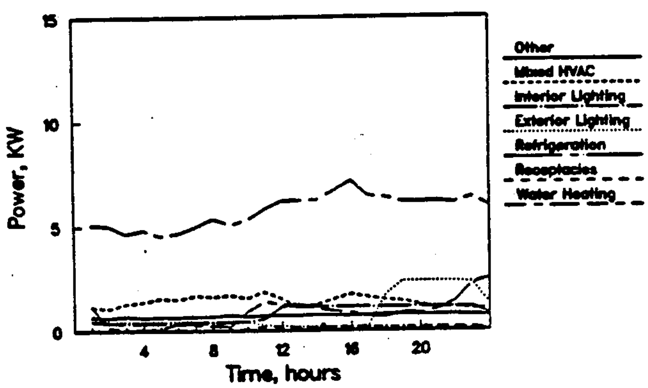
SITE 690 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



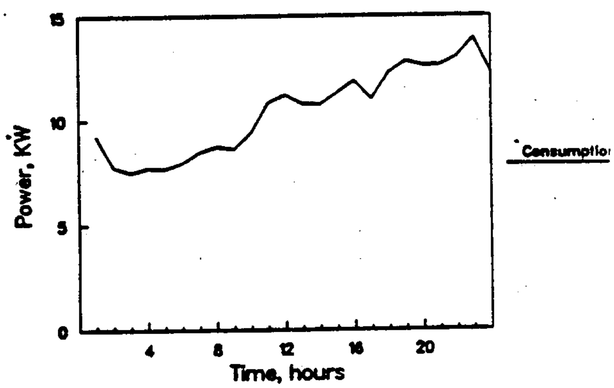
SITE 690 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



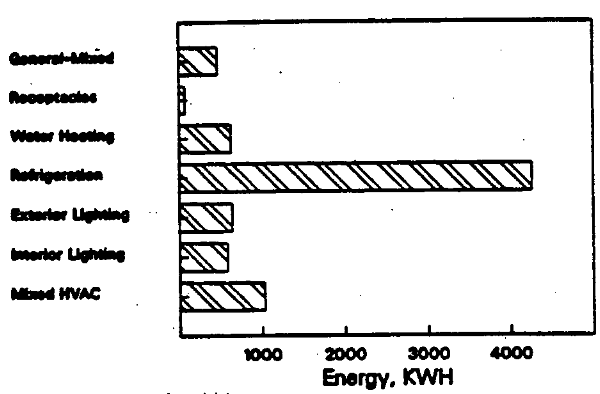
SITE 690 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 690 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID GR0101 Year Built 1962

Primary Use Retail grocery Square Feet 21,867

Hours per week 168

Yearly Consumption - Electrical - SCL Billing

1985	1,705,200 - 78.0 kwhs/sq.ft.		
1986	1,716,480 - 78.5 kwhs/sq.ft.		
1987	1.696,800 - 77.6 kwhs/sq.ft.		

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floors	Concrete slab on grade.
Walls	Concrete, no insulation except South wall, R-7
Ceiling	Built up roof, R-7 insulation
Windows	Single pane, metal frame
Sq. ft. windows	1,361

BLDG. SYSTEMS

Heating	forced air gas
Air conditioning	Direct expansion.
Hot water	Gas
Refrigeration	Central compressors & individual coolers.
Interior lights	58,610 w fluorescent 5,390 w incandescent - 2.93 w/sq.ft.
Exterior lights	Fluorescent & HPS.
Equipment I	Food prep.
Equipment II	Package handling.

GR0101 built in 1962 is similar to the other stores built in that era by a large grocery chain. Unlike their newer "super stores" this building is wide and shallow, 194 ft. wide with a 109 ft. deep customer area. The back storage and work areas are also smaller and more cramped than in their newest stores. The center part of the sales area has a rounded, built up roof, 20 feet high at the center. The side areas have a flat roof with built up roofing and a dropped ceiling. Windows extend across most of the west side store front and are single pane glass. There is greater window area in this store than in the newer stores; 1,361 sq.ft. in a 21,867 sq.ft. building.

The floor is concrete slab on grade in the front with the back of the building built into the hillside so six feet of the back wall is below grade. All walls are concrete block or stone.

Interior lights are mostly 4 or 8 ft. bare fluorescent tubes across the vaulted ceiling, and on the flat ceiling. In produce, along the north wall, there are three rows of track lighting with 84 low voltage, M16 lamps to spot light and give a different color retention to the fresh fruits and vegetables. Several of the old fluorescents are not turned on in this area. Exterior lights are fluorescent signs and canopy lights, and high pressure sodium in the parking lot and on the side of the building.

The store is located just off the street in a neighborhood shopping strip. It is open 24 hours a day. Although customer volume is high, over 2200 shoppers on some days, the parking lot in front of the store is relatively small. Foot traffic is higher in this densly populated section of town. Many of the neighborhood residents walk to the store. They appear to frequently socialize with each other and with store personnel. Several are elderly and the average time, if not average price of purchase, each spends in the store may be higher than in some other grocery stores.

Heat is provided by two forced air gas heaters; cooling by two direct expansion air conditioners. The central refrigeration system compressors are located above the back store room on a mezzanine level. Twenty-one intake fans draw in cool air from outdoors to cool the compressors and two large ceiling fans exhaust the excess heat.

Hot water is provided by a 67 gallon, gas, water heater located in the back storage area. Other equipment in the store includes meat cutting and packaging equipment, cash registers, and computer equipment. There is no in store bakery.

AUDITOR'S OBSERVATIONS

The present fluorescent fixtures could be replaced by more efficient ballasts and lower wattage fluorescent tube fixtures. There is just one set of entrance/exit doors which helps prevent loss of conditioned air. An atrium or vestibule would cut down on the blasts of unconditioned air at the check out stands.

The compressors use a great amount of electricity & supply great amounts of waste heat. Compressor efficiency can be improved. The waste heat mights be used to heat the rest of the store or to preheat the hot water.

The large front windows face directly west. There are some clear grey pull down shades and more than half of the lower windows have been blocked by greeting card racks and other displays, large 2x4 ft. paper signs announcing special prices are also attached to some of the windows. All this helps block out the heat in the summer but a more attractive and permanent solution would be a sun blocking film or replacement with tinted glass.

Bldg. ID GRO 104 Year Built 1971

Primary Use Grocery Store Square Feet 22,848

Hours per week 112

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1983 - 1,789,200 - 78 kWhs/sq.ft. March 1987
1984 - 1,738,440 - 76 kWhs/sq.ft.
1985 - 1,744,200 - 76 kWhs/sq.ft.
1986 - 1,731,240 - 76 kWhs/sq.ft.

BLDG. CHARACTERISTICS

Floor	Concrete, slab on grade
Walls	Concrete block
Ceiling	Built-up roof, R4
Windows	Single pane in aluminum frame
Sq. ft. windows	1,013

BLDG. SYSTEMS

Heating	Air source heat pump with electric resistance backup
Air conditioning	Air source heat pump
Venting	Supply and rejection fans
Hot water	2 electric tanks
Refrigeration	126,490 watts
Interior lights	45,920 w fluorescent 2,550 w incandescent - 2.1 w/sq.ft.
Exterior lights	Mercury vapor, HPS and fluorescent 20,000w estimate
Equipment I	Data processing
Equipment II	Food prep

GRO 104 is a 22,848 square foot grocery store built for a major grocery chain in 1971. It is a smaller, more basic model than their newer stores. Construction is concrete block, uninsulated walls, built up roof with R4 rigid insulation and a 3 foot space above a dropped ceiling, and uninsulated concrete slab on grade floor. The 810 square feet of clear single pane window and 203 sq. ft. of glass doors face east to the parking lot.

The store is square shape with the sales area in the front (66 percent of the total area), stockroom, restrooms, meat cooler and office are across the back third of the building. The bakery is set into the northwest corner of the sales area. The store is laid out in the most common configuration of supermarkets. The meat, open dairy and deli refrigerated cases are across the back and part way down the side walls, produce is on one side of the store and the bakery on the other, the frozen foods are down a main aisle. Staples, pet food, sundries and paper products are along the other aisles. Checkout stands are across the front of the store.

Interior lighting is provided by 95 watt fluorescent ceiling lights. Fluorescent tubes also light the display cases. In addition to fluorescent lights there are 17 150w incandescent lights over the meat counter to give a better color rendition to the meat. Exterior lighting consists of six mercury vapor entry canopy lights and six mercury vapor parking lot lights. Two high pressure sodium lights are along the north wall near the receiving dock.

Neon lighted store name signs and a bakery sign powered by high output fluorescent tubes also help light the exterior.

Heating and cooling are provided to the building by two heat pumps with electric resistance backup. Outside ventilation is provided to the compressor room. Refrigeration is a very large load in this supermarket. There are frozen food cases, ice cream freezers, refrigerated dairy, meat and drink cases, bakery refrigerated case, freezer and retarder, cold drink cases, deli cases, and a walk-in freezer, meat cooler and produce cooler. The compressors are located at the back corner of the storeroom.

Data:

Indoor lighting is a major load, 48,470 watts, 66 percent of which are on 24 hours a day and 100 percent on from 7 a.m. to 12 p.m.

Graph #1 shows the percentage of electricity for each end use during the month of March 1987. The common pattern for grocery stores shows refrigeration and interior lights as the big consumers. Heat barely shows up, even in March. The compressors for refrigeration and the lights heat up the store so more ventilation is needed.

Graph #2 gives us the daily consumption for the month. Sundays can be identified by their lower consumption.

Graph #3 shows the hourly end use pattern. Again refrigeration and interior lighting stand out, but the "other" load shows significance. It is only 13 percent of total overall load but at one time of day jumps dramatically. The food preparation equipment is included in this load.

Graph #4 gives us the profile of total load. Morning startup gives the highest peak. In late afternoon refrigeration makes a greater demand, all those lights and people have warmed up the store. Then the exterior lights come on to give us the evening peak.

Graph #5 shows total consumption by end use for the month.

<u>Auditor's Observations and Recommendations</u>:

1. Because the compressors for all the refrigeration are located inside, a heat recovery system or water heater heat pump could be used to preheat the water. In turn, cold air produced by a water heater heat pump would be a welcome year around supplement to the regular cooling equipment.

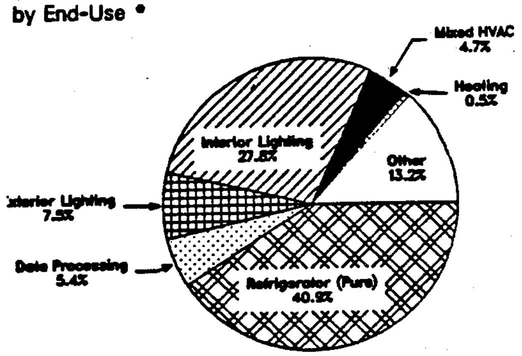
2. The incandescent spotlights over the meat could be changed to fluorescent spots with the correct color rendition. Lighting technology is changing rapidly and color has been improved. This would reduce the high heat levels in this area, a desirable feature.

3. The exterior mercury vapor lights can be changed to more efficient high pressure sodium.

4. Closed doors on the freezer cases would decrease the load on the refrigeration system and, in the winter, the heating system. The air conditioning load might be increased in the summer.

SITE 560 3/ 1/87 to 3/31/87

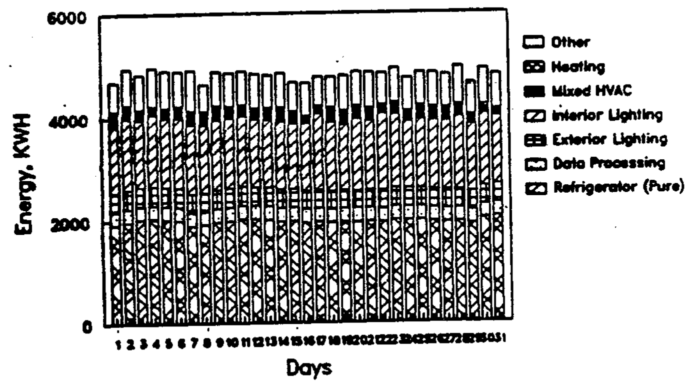
Share of Total Electricity Consumption 149,758 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

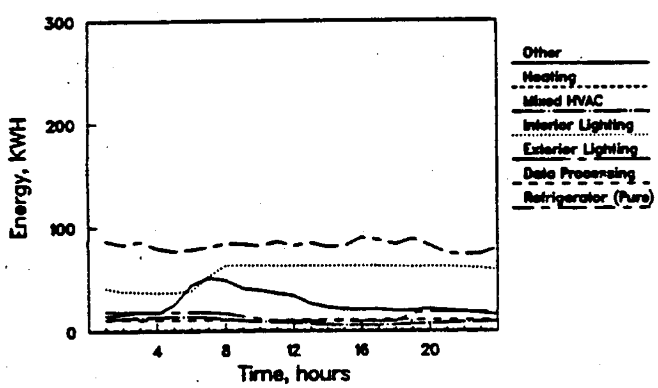
SITE 560 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



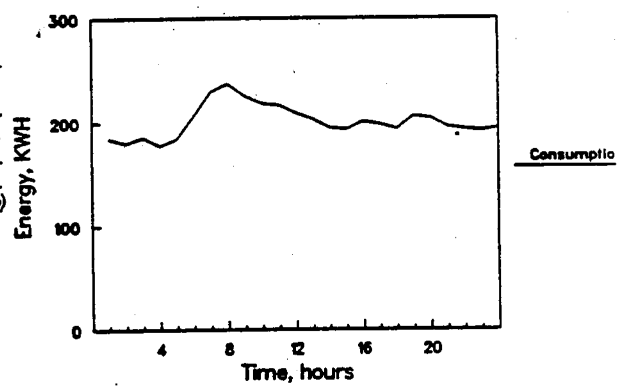
SITE 560 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



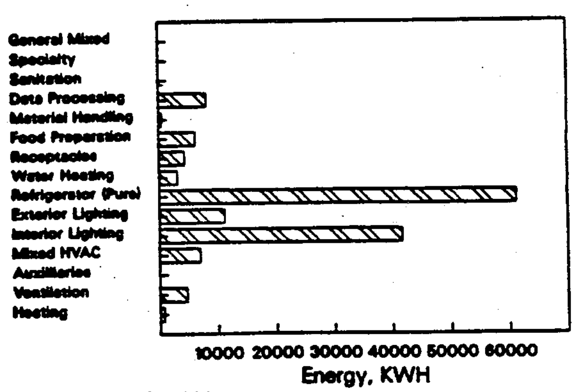
SITE 560 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 560 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID GR0301 Year Built 1982

Primary Use Deli Mart Square Feet 3200

Hours per week 134

Yearly Consumption - Electrical Available End Use Data

1985 228,160 = 71.30 kwhs/sq.ft./year
NONE
1986 240,560 = 75.18 kwhs/sq.ft./year
1987 248,240 = 77.58 kwhs/sq.ft./year average 74.68

BLDG. CHARACTERISTICS

Floor	Slab on grade.
Walls	Stucco or plywood, R-19 insulation
Ceiling	Flat Built up roof, R-30 insulation
Windows	Clear double pane in wood frames
Sq. ft. windows	387

BLDG. SYSTEMS

Heating	Air to air heat pump/electric resistance backup.
Air conditioning	Air to air heat pump.
Hot water	Electric
Refrigeration	Walk in cooler & several other freezers and coolers.
Interior lights	Fluorescent - 4294 w Neon - 2800 w Incandescent - 202 w 2.28 w/sq.ft.
Exterior lights	HPS - 60 w
Equipment I	Food prep.
Equipment II	Gasoline pumps.

GRO301 is a 3,200 sq.ft. convenience market/deli, built in 1982. As most convenience stores, it depends on the quick turn over produced by heavy traffic passing the store throughout the day and most of the night. It is open from 5:30 am, Mondays through Fridays, from 6:00 am on Saturdays and from 8:00 am on Sundays and holidays. It closes at 1 am Mondays through Thursdays, 2 am on Fridays and Saturdays and midnight on Sundays.

The 1980 Seattle Energy code dictated the building's thermal value. The flat built up roof has R-30 batt insulation on the dropped ceiling. The exterior walls are metal or stucco on plywood with R-19 batt insulation, finished on the inside with gypsum wall board. The floor is slab on grade concrete. The windows are clear, double pane glass in wood frames.

The HVAC systems is an air to air heat pump, single duct, constant volume, with electric resistance backup. There is a compressor for the walk-in cooler and one for the reach in freezer. In addition there are two beverage coolers, three plug in freezers and a regular refrigerator-freezer. There are two electric hot water heaters. Restaurant equipment includes a meat slicer, toaster oven, hot plate, food warmer, hot dog cooker, microwave oven, coffee warmers, ice machine and drink dispenser.

The lights in the main part of the store are 34 w fluorescent tubes and in the freezer-cooler cases, 50 w fluorescent tubes. There are 2,880 watts of neon signs in the store and some incandescent lights in the walk-in cooler, the sales area and in display signs. Exterior lights are HPS, incandescent and fluorescent.

When the building was originally surveyed it was owned and operated by a different person than the one who now owns it. When the new owner took over in 1987 he added some new equipment, including a deep fat chicken fryer.

AUDITOR'S OBSERVATIONS

This building was built to 1980 Seattle Energy code standards. Therefore, it presents less opportunity for energy savings than buildings built earlier.

The incandescent lights could be changed to fluorescent and the fluorescent fixtures to efficient ballasts.

Optimum operation and good maintenance are the least cost measures which will provide electrical savings at this time.

A more efficient heat pump would be expensive. However, at replacement time equipment should be carefully evaluated in order to choose the equipment which would be most cost effective to operate.

Bldg. ID GR0302	Year Built 1983
Primary Use Deli-Grocery	Square Feet 3287
Hours per week 112	

Yearly Consumption - Electrical - SCL Billing

1985 - 334,240 kwhs - 101.7 kwhs/sq.ft.
1986 - 332,160 kwhs - 101.1 kwhs/sq.ft.
1987 - 323,680 kwhs - 98.4 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Wood frame with R-11 insulation
Ceiling	Dropped ceiling - R-34 insulation
Windows	Double pane, clear, metal frames
Sq. ft. windows	396

BLDG. SYSTEMS

Heating	Air to air heat pump, electric resistance backup. Heat recovery from refrigeration compressor.
Air conditioning	Air to air heat pump
Hot water	Electric, pre heat from refrigeration compressor
Refrigeration	Central system
Interior lights	Fluorescent - 6164w > 1.9 w/sq.ft.
Exterior lights	High pressure sodium - 890w
Equipment I	Food preparation
Equipment II	Gasoline pumps

GRO 302 is a specialty food and take out deli operated by a large grocery store which is located in the next block. In 1983 it was built on their large secondary parking lot. The main street on which it is located runs through a residential area. Only the property facing this street is commercial, creating a long narrow business district. The area is being gentrified, old buildings being rehabilitated and new types of businesses moving in. There is a lot of neighborhood foot traffic as well as vehicular traffic. The building is close to the sidewalk on two sides. The doors are on the side facing the parking lot.

Wonderful sights and smells tempt you as you survey the display cases. A cheesecake lover's paradise! Across the back of the store are refrigerated cases holding the usual and not so usual beverages. A little farther out are shelves holding packaged food. To the left are the tall refrigerated display cases with salads, pastry and other inviting comestibles. Toward the back wall the sandwiches are made to order and the hot food is served. The walk-in freezer and walk-in refrigerator are in the back corner to the right. A small separate section of the store, on the north side, is a storage and food prep center. It can be reached by an outside front door, and could have been used for another shop. On the south side of the building 3 gasoline pumps are installed for a quick fill up.

The store usually has about five or six employees working at one time. The busy times are morning breakfast and coffee times, lunch hour, and late afternoon when people stop on their way home from work. The store is open from 6 am to 10 pm every day of the year. They are considering closing on Christmas day this year, something they have not done before.

The 3,287 sq. ft. frame building is constructed on a concrete slab on grade floor. Walls have R-11 batt insulation and are finished on the inside with gypsum wall board. The dropped ceiling has R-30 batt insulation, a two foot air space and then the flat roof with R3 rigid insulation under the built up roof. The clear double pane windows and doors are 340 sq. ft. facing east and 56 sq. ft. facing south.

HVAC system has an air to air heat pump with backup electric resistance heat, two heat rejection fans and one supply ventilation fan. There is also an electric resistance heater in the store room.

Refrigeration is a large load with a 240 sq. ft. walk-in freezer, a 208 sq. ft. walk-in refrigerator, an ice maker, eight refrigerated cases, under counter refrigerator and two ice cream cases. Food preparation equipment includes a hot dog machine, hot food case, coffee makers, a large bakery oven, deep fat fryer, soup warmer and various slicers and mixers.

Interior lighting is fluorescent ceiling lights. Most of the refrigerated cases also have interior fluorescent lights. Exterior lights are 14 high pressure sodium (HPS) perimeter lights and 4 HPS lights for the gas pump island. The store is at the corner of two streets and street lighting provides additional illumination.

The waste heat from the refrigeration processes is utilized by the heat pump which draws in the heated air from around the compressors. Coils going to the electric water heater also absorb some heat from the compressors. This should improve the efficiencies of both the heat pump and the water heater.

Data:

The month we have is March 1987. At 46 percent, refrigeration has the largest share of consumption, graph #1.

The interior lights, exterior lights and refrigeration show very steady daily consumption patterns on graph #2. The hourly patterns are shown on graphs #3. Refrigeration shows a rise during the day time, then declines slightly.

The food preparation shows the greatest fluctuation as the day begins, breakfast and then lunch time show up. Other loads have a low night time use: interior lighting and "other," then rise during business hours.

Exterior lighting dips slightly during the day. The HVAC drops during the day. With all the other loads coming in there is no need to add heat during the day. Summer or winter data might give us a different picture. In fact according to the billing history the electric consumption for November 1985 was 16 percent higher than for November 1986. November 1985 was an unusually cold November for Seattle. The need for extraordinary amounts of heating is a reasonable explanation for this increase.

Auditor's Observations and Recommendations:

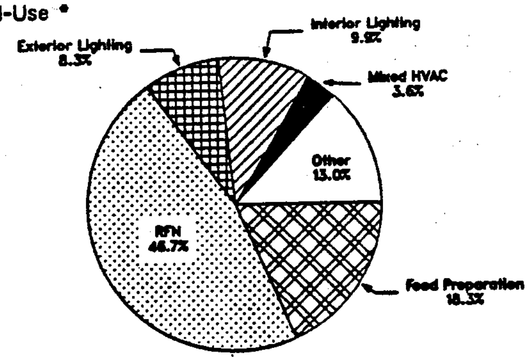
The management of the large grocery store, which has a much greater and more complicated electric load than this small shop, is aware of some energy management strategies and has used them in this building; the heat recovery for heat pump and water heaters, and the HPS lights outside and fluorescent on the inside.

This is a newer building and insulation levels are fairly high. However, a much larger factor is how often the doors are opened, letting the conditioned air be replaced with unconditioned air. For the quick in and out business with people carrying servings of food, double doors to form an air lock entry are impractical unless it had automatic doors--and then both doors would be open at the same time.

Usually cooling is a larger load than heating because of the internal gains from all the heat producing equipment. Careful monitoring of the temperature settings and time controls is required to obtain optimum efficiency from their system. Good maintenance practices are also important.

SITE 297 3/ 1/87 to 3/31/87

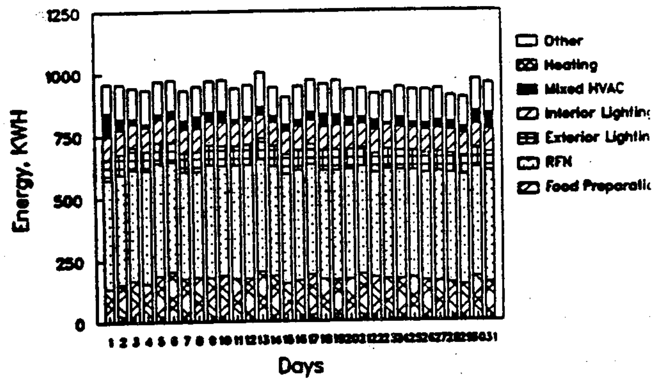
Share of Total Electricity Consumption 29,304 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

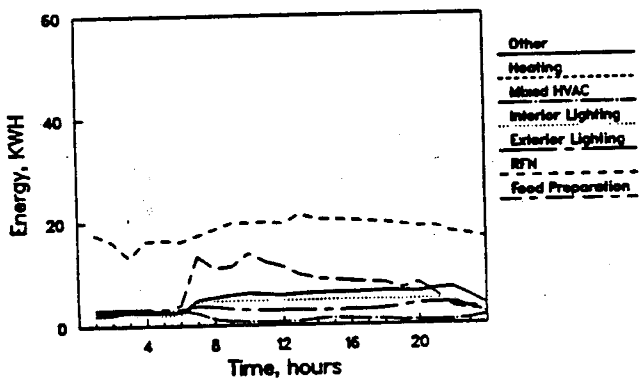
SITE 297 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



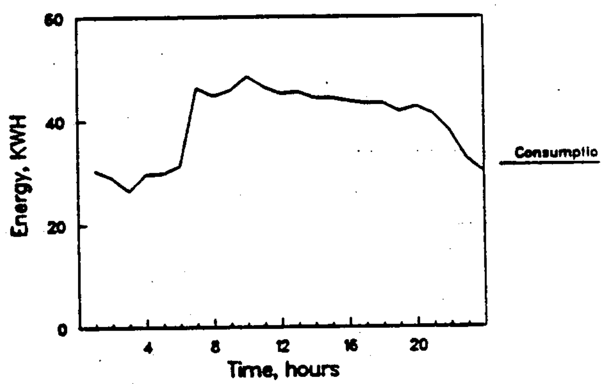
SITE 297 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



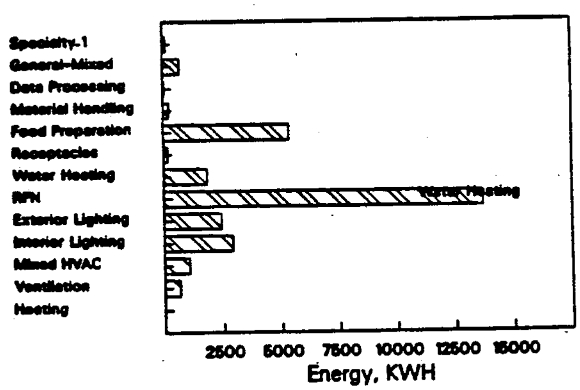
SITE 297 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 297 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID GR0401 Year Built 1981

Primary Use Retail grocery Square Feet 22,232

Hours per week 168

Yearly Consumption - Electrical - SCL Billing

1985	1,379,280	- 62.0 kwh/sq.ft.
1986	1,432,320	- 64.4 kwh/sq.ft.
1987	1,453,200	- 65.4 kwh/sq.ft.

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Concrete, R-11 insulation.
Ceiling	Built up roof R-19.
Windows	Double pane, tinted, metal frame.
Sq. ft. windows	432

BLDG. SYSTEMS

Heating	Air to air heat pump, electric resistance heat. Heat recovery from compressor room.
Air conditioning	Direct expansion air conditioning, for computer room
Hot water	2 electric hot water heaters.
Refrigeration	central compressors.
Interior lights	28,440 w fluorescent 700 w incandescent - 1.31 w/sq.ft.
Exterior light	Use photo cell and time clock.
Equipment I	Food prep.
Equipment II	Cash registers - computers.

GRO401 appears much like all the other super markets of this chain. However, the 22,232 sq.ft. store was built in 1981 and had to meet the energy code of that time. The concrete walls of the retail space have R-11 insulation. The outside walls of the compressor room and a small portion of the front walls under the windows are not insulated. The ceiling has R-19 batts insulation on the underside of the built up roof. There is a six foot air space and then a dropped ceiling over the sales area. The 432 sq.ft. of tinted, double pane windows face south towards the parking lot. The windows are smaller than in older stores. There are several trees along the street and a two story building across the street, but these are not close enough to block the summer sun. The floor is insulated concrete slab on grade. The store also has a front vestibule. The automatic doors open at the sides of the vestibule, rather than directly into the check out areas, as they do in most of the older stores. This shortens and redirects the infiltration path of unconditioned air.

Interior lighting is fluorescent ceiling fixtures. There are 400 w of incandescent lights in the rest rooms and 300 w in the walk-in freezer and refrigerator. Refrigerated cases and freezers have fluorescent lights.

Exterior lights are incandescents in the eight soffit lights and HPS in the four parking lot lights. There are three large signs which probably have high output fluorescent tubes.

Street lighting in this busy district near the Seattle Center helps illuminate the area.

Heat pumps with electric resistance heat and heat recovery from the refrigeration compressors are the main sources of HVAC. The computer room has its own room air conditioner.

Although the store was built in 1981 it does not have all the amenities now expected in an urban store surrounded by apartments, businesses and the popular Seattle Center. Therefore, in the last half of 1988 the store will undergo several equipment and lighting changes to provide a full service deli and a specialty foods section.

The store is open 24 hours a day closing only on Thanksgiving and Christmas. The customers are usually not large families doing their weekly shopping, but working singles or couples stopping off for something quick and easy or people going to Seattle Center wanting to pickup something to eat or drink in the park.

AUDITOR'S OBSERVATIONS

The management pays attention to operation and maintenance in the building which is the most valuable thing they can do to ensure efficiency.

As new lighting technologies come on the market they should be studied to see if they will be cost effective for this store. As other new equipment is purchased and as spaces are remodeled energy efficiency of equipment should be considered.

Compared to other groceries of this size and with this kind of equipment this store uses fewer kwhs per sq.ft. than the others.

Bldg. ID HTM101 Year Built 1930-40 several remodels

Primary Use Fraternity House Square Feet 7,041

Hours per week 168

Yearly Consumption - Electrical

1985 154,430 - 21.93 kwhs/sq.ft.
1986 162,437 - 23.07 kwhs/sq.ft.
1987 151,351 - 21.50 kwhs/sq.ft.

Available Data

NONE

BLDG. CHARACTERISTICS

Floor	--
Walls	6 types - about 28% has R-11 insulations, 72% no insulation.
Ceiling	33% has R-33 insulation, 67% no insulation.
Windows	Single pane in wood frame.
Sq. ft. windows	1,558

BLDG. SYSTEMS

Heating	Gas/oil fired boiler
Air conditioning	
Hot water	Gas water heater
Refrigeration	Central compressor plus smaller loads.
Interior lights	1,280 w fluorescent 51,120 w incandescent
Exterior lights	840 w incandescent
Equipment I	Kitchen equipment
Equipment II	Personal TV's, stereos, PC's, etc.

Bldg. ID OFB001 | Year Built 1960

Primary use Bank | Square Feet 2,921

Hours per week 39 open + 10 with employees

Yearly Consumption - Electrical | Available End Use Data

1985	133,440 - 45.7 kwhs/sq.ft.	April 1986
1986	137,200 - 47.0 kwhs/sq.ft.	
1987	111,920 - 38.3 kwhs/sq.ft.	

BLDG. CHARACTERISTICS

Floor	Concrete basement
Walls	Concrete, wood frame and brick veneer
Ceiling	Attic - R11 insulation
Windows	Single pane in wood frame
Sq. ft windows	282

BLDG. SYSTEMS

Heating	Electric resistance duct heaters
Air conditioning	Direct expansion
Hot water	30 gallon electric
Refrigeration	Minor
Interior lights	Fluorescent - 7608w Incandescent - 1535w 3.1w/sq.ft.
Exterior lights	Photocell - incandescent 2550
Equipment I	Data processing equipment
Equipment II	Office equipment

OFB001 is a neighborhood bank which is part of a small, concrete, wood frame and brick veneer complex, built into the side of a hill. It faces a busy thoroughfare. The bank section has two levels, with a west-facing parking lot and level entry into the main lobby on the upper level. The lower level is a daylight basement exposed on the east. The vault is located under the parking lot. It is accessed from the lower level lobby.

The bank is oblong, running north to south with a small insert of another business into the southwest corner on the upper floor and on the lower level an apartment at the south end. The upper floor has 1542 sq. ft. of essentially open space with a small enclosed conference room at the south end. Two, large single pane, bronze, film coated windows and double doors face the west parking lot. There are two large, clear, single pane windows on the east and two small windows on both the north and south walls. An open fireplace, located on the east wall of the main lobby area has a gas fired log which burns during business hours. It is vented by a conventional chimney.

The lobby area is in the center, tellers at the north end, manager and two other personnel at desks to the south of the lobby. The ceiling is 9 feet high. An open stairway using 65 sq. ft. of floor space, leads to the 1,068 sq. ft. lower level, smaller than the upper level as the apartment occupies 23 feet on the south end. Large, single glazed, clear windows in wood frames face the east. A solid wood core door leads to the outside. To the north is a separate kitchen-lounge. Restrooms and utility room occupy a small section of the space. The 311 sq. ft. vault opens to the lobby area. it is secured by a stainless steel gate during the business day. At night, the vault door is closed. There are no windows. The floor, ceiling and walls are all 12 inch, reinforced concrete, which is below ground. There are 12 inches of earth and an asphalt parking area above.

The building was constructed in 1960. The bank has been there since 1972. All walls, above and below grade, are insulated to R-11. The flat roof has a three-foot cavity with R-11 insulation. The windows are single glazed. The west windows have had a bronze film applied to cut down on the heat gain from the sun and from the asphalt parking lot.

Inside lighting is manually controlled ceiling fluorescent fixtures. The restrooms, stairwell, storeroom and an occasional desk lamp have incandescent bulbs.

Outside incandescent lighting is the 24 hour time and temperature sign and soffit lights around the building, operated by a photocell.

Electric resistance heaters provide heat to the building, cooling is provided by 2 conventional air conditioners.

DATA

The data for this site appears to be faulty. There are another business and an apartment in the building. The April heating load on these graphs looks more like residential use; considerably more heat in evening and during the night than during the day total. The consumption also does not agree with SCL billings.

The July graph looks more like a bank building. There are some variations of general mixed load. HVAC shows greater variation and is probably sensitive to outdoor temperature.

Observations and Recommendations:

The doors in the main lobby are opened frequently during the day. Unconditioned air is drawn in. The open fireplace on the opposite wall is continuously drawing conditioned air out of the building.

1. An air lock entry and glass doors on the fireplace would cut this high rate of infiltration and exfiltration. It would make the lobby more comfortable by eliminating blasts of unconditioned air and would decrease noise and dirt from the passing traffic.

2. The open stairwell contributes to the heat loss in the lower level. A high ceiling fan above the stairwell would push, or a wall duct/fan would pull, the heated air back down.

3. The exterior incandescent spotlights could be changed to high pressure sodium (HPS) which would provide a great Kwh savings, but would give a slightly pink color. Fluorescent spotlights would provide excellent savings, not as great as HPS, but would give the same color rendition as the incandescent bulbs.

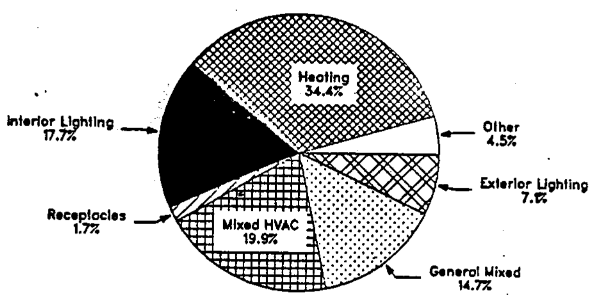
4. The occasional interior incandescent lights could be easily changed to fluorescent. More insulation could be blown into the roof cavity to bring it up to R-38. This would cut the summer air conditioning load and the winter heat load. This is a relatively low-cost measure.

5. There is little space in the parking area, but planting a couple of decidious trees to shade the asphalt and front windows would cut down on the summer solar gains and air conditioning load. It would also be an attractive addition to the grounds.

A change of systems, using heat pumps instead of the air conditioners and heaters would greatly increase the building's conditioning efficiency. The initial cost would be high, but it is a measure which should be considered. There would be a savings in winter as electric resistant heat is now being used. Heat pumps would provide air conditioning when needed in the warm weather.

SITE 565 4/ 1/86 to 4/30/86

Share of Total Electricity Consumption 18,235 KWH by End-Use *

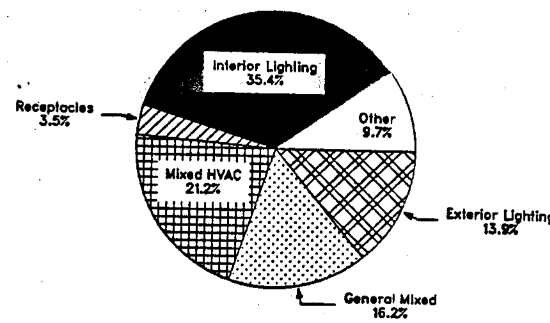


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 565 7/ 1/86 to 7/31/86

Share of Total Electricity Consumption 8,529 KWH by End-Use *

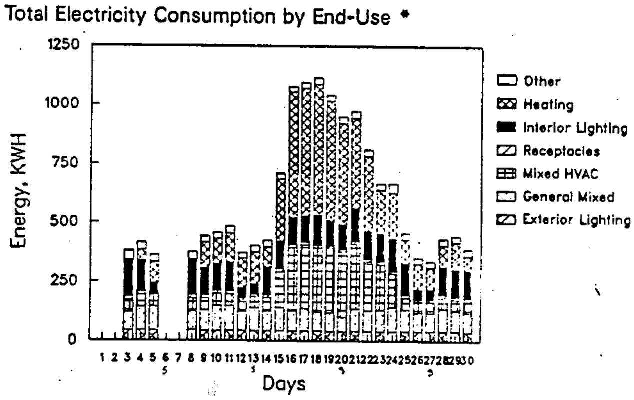


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 565 4/ 1/86 to 4/30/86

Total Electricity Consumption by End-Use *

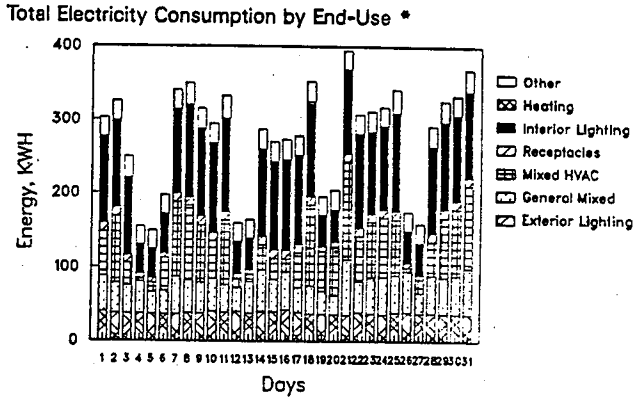


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 565 7/ 1/86 to 7/31/86

Total Electricity Consumption by End-Use *

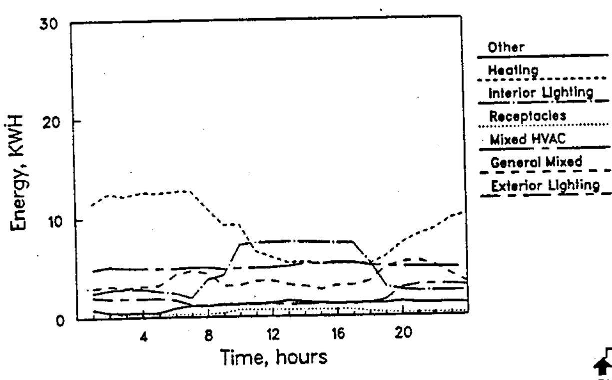


* Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 565 4/ 1/86 to 4/30/86

Average Daily Electricity End-Use Profile

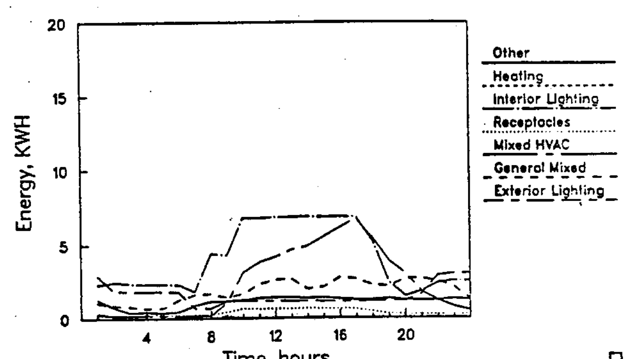


Sample size = 1

ELCAP

SITE 565 7/ 1/86 to 7/31/86

Average Daily Electricity End-Use Profile



Sample size = 1

ELCAP

Bldg. ID OFB002 | Year Built 1963

Primary Use Bank | Square Feet 2,928

Hours per week 46

Yearly Consumption - Electrical - SCL Billing

1985 - 42,076 - 14.37 kwhs/sq.ft.
1986 - 40,235 - 13.74 kwhs/sq.ft.
1987 - 41,579 - 14.2 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	8 in. concrete
Ceiling	flat, R-3 rigid foam
Windows	single pane, aluminum frames
Sq. ft. windows	1135

BLDG. SYSTEMS

Heating	forced air gas
Air conditioning	direct expansion
Venting	rejection and supply, circulation
Hot water	70 gallon electric
Refrigeration	
Interior lights	6,920 w fluorescent 1,328 w incandescent - 2.8 w/sq.ft.
Exterior lights	____ w fluorescent 900 w incandescent
Equipment I	data processing
Equipment II	auxiliaries to gas furnaces

OFB 002, a branch of a local savings and loan institution, was built in 1963. There have been no basic changes in the building. The bank is located in a slow paced neighborhood business district, a little run down at the heels. This builidng is one of the newer and more attractive in the neighborhood. There is no drive-up window. Many of the customers walk to the bank. A small parking lot is located on the north side of the building. There are no parking lot lights, street lights provide illumination for the area. The building is used five days a week, nine hours a day, open 9:30 a.m. to 5 p.m. Monday-Thursday and 9:30 - 6 p.m. on Friday. There are usually about 7 employees in the bank.

There are 2,114 sq. ft. of open lobby, the major portion of this one story building with a 12.5 ft. ceiling. The 814 sq. ft. remainder which includes the vault, rest rooms, storage and mechanical rooms, and has an 8.5 ft. ceiling. The floor is concrete slab on grade. The flat built-up roof has one inch of rigid insulation - R3, a two foot air space and a suspended acoustical ceiling. A twelve inch reinforced concrete ceiling is over the vault. Walls in the bank are eight inch concrete block with one inch furring, finished with gypsum wallboard on the interior. The vault has 16 inch reinforced concrete walls.

Windows are single pane glass in aluminum frames. 550 sq. ft. face north, 419 sq. ft. west, creating ceiling to floor glass walls on these elevations. South and east each have 83 sq. ft. of windows, a high 1 to 2.5 ratio to floor space. Draperies are installed over all the windows.

Doors are just one set of entrance doors with double pane glass in aluminum frames.

HVAC system is a gas furnace, two direct expansion air conditions, two heat rejection fans and supply ventilation fans and a circulation fan. The vault has electric radiant heaters. A 70 gallon electric water heater supplies hot water for the building.

Most of the interior lights are 40w fluorescent tubes in the original ceiling fixtures, a total of 6,920 watts. For night security 640 watts of these are left on. Incandescent bulbs are used in store room, rest rooms, mechanical rooms and desk lamps for a total of 1,328 watts.

Exterior lights are a fluorescent sign turned on by timer from 7 p.m. to 6 a.m. and 9 - 100w spotlights in the building soffit, controlled by timer to be on from 7:15 p.m. to 6:30 a.m.

The usual bank equipment includes computers with disk drives, VDT's, adding machines, printers, postage meter, typewriters and a copier. The employee kitchen has a range with oven, refrigerator and microwave.

Data:

The enduse data from PNL and the SCL billing history confirm that, for commercial customers, OFB 002 is a small electric user.

The enduse data for this one month shows 51 percent of the consumption is used for interior lighting and 20 percent for exterior lighting, graph #1. Both offer good opportunities for conservation, see observations #1, 2, 3 and 5.

Cooling is a small load at this time of year. In the summer it is a more significant load. Billing history shows higher total electric consumption in the summer months. (In the winter heat is gas.) On graphs #2 and #3 we see that the air conditioning is a constant load every day, even on weekends. This is addressed in suggestion #6.

Graph #2 also shows higher use of the auxiliaries on the first two weekends of the month, indicating someone forgot to turn down the thermostat. Those days also used more energy than a normal day, indicating the unusual night time use and maybe less internal gain because most of the lights and other equipment were turned off. On the 4th and again on the 20th of the month we see a drop in the very consistent exterior lights. They then follow that line. Either a light burned out and wasn't replaced, then another burned out and was not replaced, or the time clock was changed because of the longer hours of daylight as spring approaches.

The daily auxiliary enduse seems to be temperature sensitive. Fridays reflect the longer hours open and the greater use of "other" equipment.

Graphs #3 and #4 show how the individual loads contribute to the peaks. Interior and exterior lights drive the shape of the load. The morning peak is caused by the interior lights and the heat auxiliaries. The highest peak is where they cross in the evening and other equipment is still being used.

Auditor's Observations and Recommendations:

1. A simple change of the 100w incandescent lights in the soffit to 35w high pressure sodium, would give twice the light for one-third of the power. They would also last 16 times as long, cutting the maintenance cost of installing them in the building soffit.

2. Interior incandescent lights could be changed to fluorescent light fixtures.

3. The 70 gallon hot water heater should be replaced with instantaneous, at the source, heaters. There is now a 24 hour a day every day standby loss for the hot water which is used infrequently.

4. A more complicated and costly retrofit would be to change the 40w fluorescent tube ceiling fixtures to 32w efficient fluorescent tubes with electronic ballasts and reflectors. Not as many lamps would be required. Dual switching would allow only part of the lamps to be on when outdoor light levels are high and can be utilized.

5. Better control of the HVAC system would turn off the air conditioners at night and prevent heating and cooling from running at the same time.

6. The two air conditioners and the furnace could be replaced by efficient heat pumps with back-up gas heat. They could be installed to condition individual zones and provide a more even temperature in all zones.

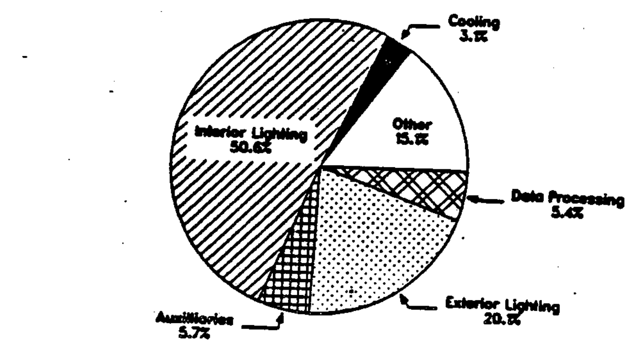
Shell measures, such as adding ceiling insulation when a new roof is installed might be considered. There would be some savings on heating in winter and cooling in summer.

8. Replacing the windows would be very expensive. The building is limited to day time use. Night heat loss is not a consideration, therefore double pane windows would not be cost-effective.

9. Reflective film might be added to the west window wall and to the south 83 sq. ft. of windows. This would cut down on air conditioning demand in summer but be counter-productive in the winter. There are draperies that are used to control the sunlight, when desired. This is the practical thing to do.

SITE 547 3/ 1/87 to 3/31/87

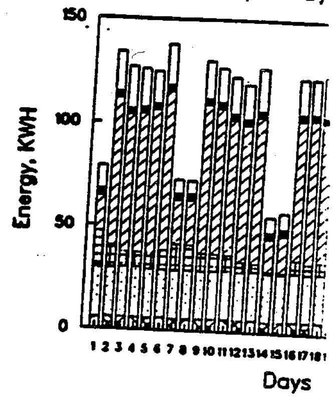
Share of Total Electricity Consumption 3,329 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

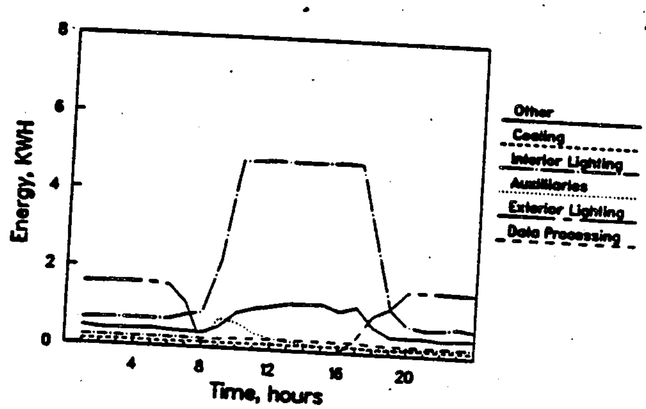
SITE 547 3/ 1/87 to 3,

Total Electricity Consumption by



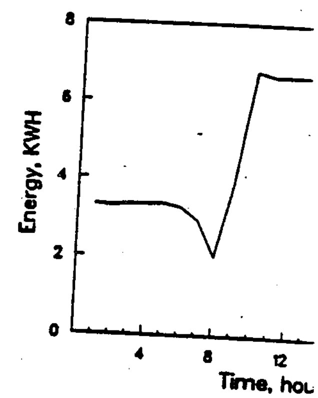
SITE 547 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



SITE 547 3/ 1/87 to 3,

Average Daily Total Electricity U



TAT 03 ACTIVE

DATE	DAY	CONS	0C	DEMAND
0410	60	6320	1	
0209	61	6501	1	
1210	63	6108	1	
1008	61	8146	1	
0808	59	7740	1	
0610	61	6444	1	
0410	61	6495	1	
0208	60	5894	1	
1210	63	6312	1	
1008	61	6267	1	
0808	59	9323	1	
0610	61	6245	1	
0410	62	6719	1	
0207	59	7240	1	

01 OF 01 MTRS 1200826

AMOUNT	ACCTS REC	
161.79	TOTAL	0.00
273.69	CURR	161.79
257.15		
208.54	FLAT	0.00
198.35	RNTL	0.00
155.34	MISC	0.00
135.05	TSF	0.00
211.33	ARR	0.00
216.92	DUE DT	5/01/87
136.62	APP	0
203.24		
136.14		
146.47	TSF	
270.38	CD	

Seattle City Light

Bldg. ID	OFB003	Year Built	1965
Primary Use	Bank	Square Feet	5432 heated, 591 unheated
Hours per week	36		

Yearly Consumption - Electrical - SCL Billing

1985 - 133,760 - 22.2 kwhs/sq.ft.
1986 - 102,560 - 17.0 kwhs/sq.ft.
1987 - 90,400 - 15.0 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete, slab on grade
Walls	Brick, veneer, no insulation
Ceiling	Concrete, R-8 insulation
Windows	Single pane, tinted glass, metal frames
Sq. ft. windows	1802

BLDG. SYSTEMS

Heating	Forced air gas
Air conditioning	Direct expansion AC
Hot water	50-gallon gas
Refrigeration	--
Interior lights	2,768 w fluorescent 9,139 w incandescent - 1.85 w/sq.ft.
Exterior lights	3,440 w fluorescent 2,826 w incandescent
Equipment I	Office equipment
Equipment II	Outlets

OFB 003 is a 4,004 sq.ft. bank with a 345 sq.ft vault inserted at the SE corner. It is tall and square, has a flat roof with a four foot overhang. The ceiling is 18 feet except over the teller area where it is 8'4". Above this is a 1,428 sq.ft. heated and 310 sq.ft. unheated enclosed mezzanine reached by an enclosed stairway behind the tellers' area. The employee lounge, restrooms, storage and mechanical room are located on this second level. Another 281 sq. ft. mechanical room is above the private conference room in the northwest corner across the lobby. The drive-up window is on the south wall behind the tellers. The main lobby and customer areas are two stories tall.

The bank was built in 1965 in a suburban business area on a busy street. It is surrounded by a large parking lot. The style is "modern". Tall windows to the 18 ft. ceiling are on three sides. The single pane, tinted glass covers 1802 sq. ft. of wall area. Windows have draperies on all but those that flank the entrance doors.

Uninsulated brick veneer walls make up most of the south wall and about a third of the north and west walls. The other small wall areas below the tall windows and near the ground level are vinyl with 2 inch rigid insulation, R-5. Decorative marble covers 420 sq.ft. of the uninsulated east wall.

The uninsulated floor is concrete slab on grade. The flat roof is concrete, with R-8 insulation and a built up roof.

The HVAC system has four forced air gas furnaces and four direct expansion air conditioners. Each has a heat rejection fan and supply ventilation fan. Hot water comes from a 50 gallon gas hot water heater.

Interior lights, which are on during open hours, are fluorescent ceiling fixtures. There are incandescent lights in the office area, the restrooms, storage and mechanical rooms and the stairway. The large windows which extend up to the ceiling provide extensive day lighting.

Exterior lighting is primarily the incandescent spot lights under the soffitt, controlled by photocell. The lights above the bank machine, the lights for the drive-up window and a sign, which are on a time clock. The large name signs have high output fluorescent tubes inside. The parking lot lights are high intensity discharge halogen, controlled by photocell.

Most of the end use loads are monitored individually, however the outdoor lights and outdoor signs are all counted as exterior lights.

The bank is a busy branch of a large Seattle institution, open from 10 am to 5 pm during the week and from 10 am to 6 pm on Fridays. The drive-up window is open all five weekdays from 9 am to 6 pm and many customers take advantage of its convenient location. Employees arrive at 8 am and leave one hour after the bank closes.

Data:

The graphs for the month of March 1987 give a good general overview of load share of each enduse, (#1 and #5). The daily use on graph #2 clearly shows weekday versus weekend loads. The variations in exterior and interior lighting is not easily explained. Some exterior lighting is on a photocell, others are on a time clock. If these devices are functioning and/or are reset frequently we should see a gradual decrease in exterior lighting as the hours of day light increase dramatically in March at latitutde 47° North. Cloudy days may also effect the photo cell operation. But interior lighting load is also erratic, indicating inconsistent turning on and off of lights. A few months more data and close observation of internal behavior might help explain the variations. A 3D graph would also show which days and at what time spikes occur, giving some clues as to what to look for.

Graph #3 gives the time of day average end use. Lighting determines the shape of the electric load, with an assist from "other" and the HVAC system.

Auditor's Observations and Recommendations:

1. The exterior incandescent lights in the soffit could be changed to fluorescent spot lights.

2. The incandescent lights inside the building could be changed to fluorescent. Low wattage fluorescent tubes and efficient ballasts could be used in the ceiling fixtures.

3. Better control of the lighting could be achieved with automatic dimmers for sunny days and occupancy sensors for employee lounge and restrooms.

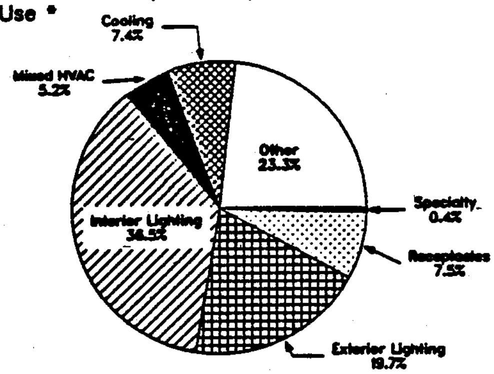
4. The 50 gal. gas hot water heater provides enough hot water for a family with five teenagers showering and washing their hair twice a day. Most of the energy which goes into it comes out as stand-by loss. "At the source" or instantaneous hot water heaters would be a large initial investment. But there is such a small demand for hot water it should be considered. Or, at least consideration should be given to installing a smaller tank.

5. The entire HVAC system could be re-done, to provide a more efficient system, but at great cost.

6. Shell measures are not recommended as the building is only used 5 days a week, during day time hours. Large double windows would be expensive. It would be possible to add more insulation to the flat room when it is time to re-roof. This measure would produce both heating and cooling savings.

SITE 600 3/ 1/87 to 3/31/87

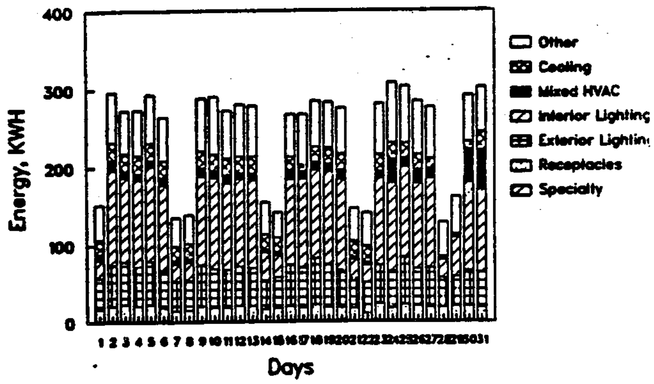
Share of Total Electricity Consumption 7,551 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

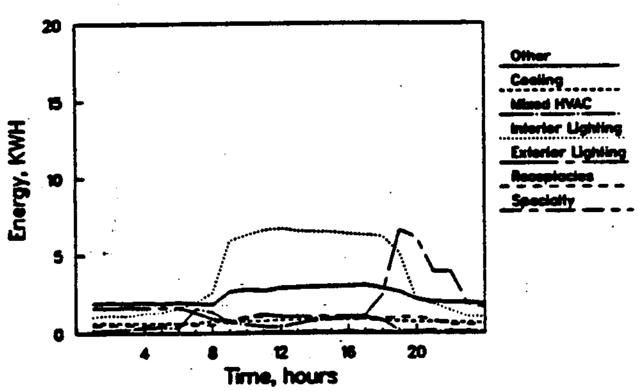
SITE 600 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



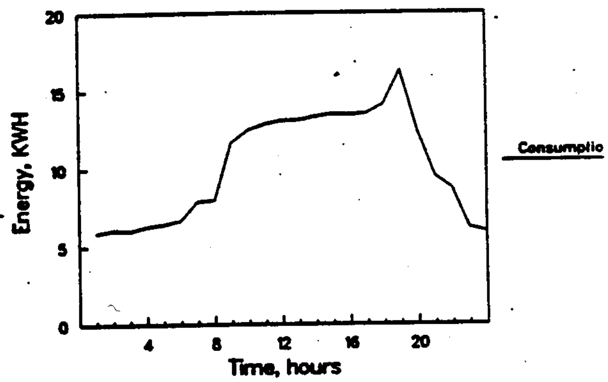
SITE 600 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



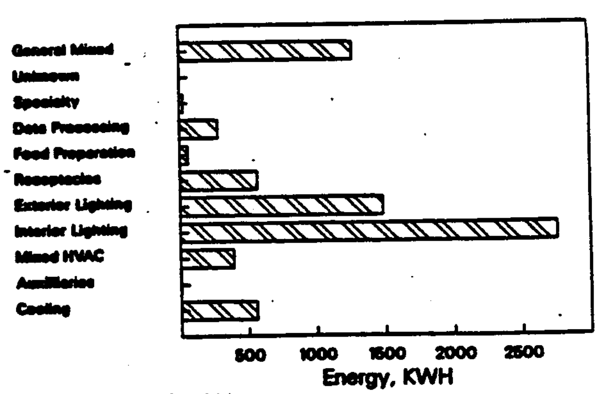
SITE 600 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 600 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID OFB004

Year Built 1970

Primary Use Bank

Square Feet 6,032

Hours per week 47

Yearly Consumption - Electrical

1985	102,240	- 16.95 kwhs/sq.ft.
1986	77,600	- 12.86 kwhs/sq.ft.
1987	77,480	- 12.84 kwhs/sq.ft.

Available Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Woodsiding, R-11 insulation.
Ceiling	Attic with R-19 insulation.
Windows	Single pane, tinted glass, in metal frames.
Sq. ft. windows	1,147

BLDG. SYSTEMS

Heating	Air to air heat pump, electric resistance strip heaters.
Air conditioning	Heat pump plus direct expansion air conditioner.
Hot water	20 gallon electric water heater.
Refrigeration	--
Interior lights	6,800 w fluorescent 180 w incandescent - 1.16 w/sq.ft.
Exterior lights	--
Equipment I	Office equipment
Equipment II	--

Bldg. ID OFB103

Year Built 1977

Primary Use Bank office building

Square Feet 38,766

Hours per week 50

Yearly Consumption - Electrical - SCL Billing

1985 983,520 - 25.4 kwhs/sq.ft.
1986 913,680 - 23.6 kwhs/sq.ft.
1987 907,200 - 23.4 kwhs/sq.ft

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Slab on grade - concrete - no insulation cantileser concrete - no insulation
Walls	Precast concrete - no insulation Architectural glass - R6 insulation
Ceiling	Built up roof. R19 insulation
Windows	Single pane, bronze
Sq. ft. windows	6,892

BLDG. SYSTEMS

Heating	Electric boiler
Air conditioning	Two compressor systems
Hot water	120 gallon electric with circulating pump
Refrigeration	--
Interior lights	62,811 w fluorescent 19,450 w incandescent - 2.1 w/sq.ft.
Exterior lights	2450 w - HID 4750 w - incandescent
Equipment I	Office equiment
Equipment II	Elevator

OFB103 is a five story bank building with a partial basement and an open parking area under the building. It is an attractive, modern looking, glass and precast concrete building located on the fringe of downtown Seattle. It was built in 1977 and is still waiting for the rest of the neighborhood to improve to it standards. It stands alone, surrounded by parking lots.

Because it was built before the 1980 energy code the thermal values of the shell are low. 64% of the walls are concrete with no insulation, finished on the inside with wall board. 36% of the walls are glass with one inch foam insulation and finished on the inside with wall board. The cantilivered concrete floor over the parking area and at the front of the building has no insulation.

The flat, built up roof has 1½ inches of rigid foam. The windows are all bronze tinted, single pane glass in aluminum frames. Office windows have venetion blinds to help control light. In 1987 the sloped garden windows on the northwest side were coated with reflective film to cut the solar gain. In 1989 all the 5th floor windows will also be coated as the comfort level has been increased by this measure.

When originally designed the building was to have three floors. But then the 4th & 5th floors were added. This has complicated the HVAC system. An electric boiler serves the entire building for heating. Two compressors provide cooling, one for the basement through 3rd floor and another for the 4th and 5th floors. A new energy management system was installed in June 1986. The occupants have noticed improvement in the regulation of the HVAC system. Also the yearly billing histories show a decrease in consumption.

The original survey was done before the EMS was installed and the end use data will be for after installation.

A credit union owns the building and occupies most of it. The first floor contains the banking lobby and customer services. There is no obvious public entrance to the office elevator which is around the corner from the entrance.

The upper floors contain the credit union offices, a small travel agency and one floor is half vacant.

The interior lighting is mostly 4 foot, 40 watt fluorescent tubes. The first floor "bank" area has several incandescent spot lights and there are some incandescent bulbs in halls and restrooms. The exterior lights are controlled by photo cell and include 1400 watts high pressure sodium in parking areas and 4750 watts incandescent at the entrances and on the roof of the building.

Because it is a financial institution there are numerous computers and other electronic equipment. The domestic hot water is furnished by a 120 gallon electric water heater with a circulating pump. Other loads are a few coffee makers and small refrigerators.

Hours are regular office and bank hours, 8 am to 5pm with a few people coming in at 7:30 am and a few staying until 5:30 pm.

<u>AUDITOR'S OBSERVATIONS</u>

The sun blocking film on the windows and the new EMS were good strategies for comfort and for energy savings.

As this is a five days a week, day time only building, any thermal improvement measures would have a long pay back time. When a new roof is installed more rigid insulation could be added to the flat roof deck.

The interior incandescent lights could be changed to fluorescent and the exterior incandescents could be changed to high pressure sodium.

Careful control of the energy management system will result in optimum savings. The circulating pump can be turned off at night and on weekends.

Bldg. ID	OFB 301	Year Built	1984
Primary Use	Bank	Square Feet	3157
Hours per week	41		

Yearly Consumption - Electrical

1985	75,040 kwhs	- 23.8/yr.
1986	72,840 kwhs	- 23.1/yr.
1987	63,840 kwhs	- 20.2/yr.

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Wood
Ceiling	Built-up roof, R-30 insulation
Windows	Clear, double pane in metal frames.
Sq. ft. windows	707

BLDG. SYSTEMS

Heating	Air-to-air heat pumps with electric resistance back-up	
Air conditioning	air-to-air heat pumps	
Hot water	6 gallon and 52 gallon electric	
Refrigeration	-	
Interior lights	4463 w fluorescent 3869 w incandescent	2.6 w/sq. ft.
Exterior lights	4450 w incandescent 300 w HID	
Equipment I	Data processing	
Equipment II	Office equipment	

OFB 301, built in 1984, is the newest bank in the ELCAP sample. The 3152 sq. ft. building is located in an affluent, residential neighborhood. There are no other commercial buildings nearby. The style is Northwest Contemporary: a wood building with flat built up roof and a 13-foot wide center section which has a peaked, metal roof. The ends of this section are double pane windows in metal frames. The flat roof is 13 feet high from the floor, the peak, in the center, 15 feet from the floor. There is R-30 insulation in all of the roof. The wood walls have R-11 and the slab on grade floor is equivalent to R-25. The windows at each end of the oblong building and the smaller ones on each are double pane and provide daylighting to the lobby.

Interior lighting is mainly 4 foot fluorescent tubes recessed behind wood trim to bounce light off the sloped ceiling, and incandescent recessed spotlights over the tellers stations on one side and the customer representatives' desks on the other side.

Exterior lights are mostly incandescent which are controlled by the same circuit as the conference room, so are on during the day. There are two high pressure sodium pole lights on photocell for the parking lot.

HVAC, both heating and cooling, is provided by three single duct, constant volume heat pumps with electric resistance back up heat. There is also an electric resistance baseboard heater in the tellers' area.

The open concept interior and low key atmosphere fit in well with the neighborhod surroundings. Only the employee lounge area and a small conference room are closed off. There are usually four employees and about three customers in the bank at any one time. Hours are 9 a.m. to 4 p.m. Monday through Thursday and 9 a.m. to 6 p.m. on Friday.

Data:

The March 1986 data for OFB 301 in Graph #2 shows a building with consistent consumption directly related to operating hours. The chief difference seems to be outside lights which on Fridays show about a 30 percent increase over the other days. Mixed HVAC and heating are the other loads that show some variation. Graph #3 shows the morning peak which incurs a demand charge. If this could be evened out, the demand charge would be less.

Auditor's Observations and Recommendations:

This is one of the buildings also included in Seattle City Light's CHEUS (Commercial Hourly End Use Study). Conservation analysis was done on this building in 1986. Two preliminary measures were recommended:

1. Insulate the 40 gallon electric hot water heater.

2. Reduce the set back temperature from 68° to 60°.

The building simulation, using DOE 2.1B was then done. It was determined that only two measures were cost effective.

1. Adding a photoelectric switch to keep exterior lights off during the daylight hours. (Simple payback 5.1 years.)

2. Install motorized return air dampers in duct above ceilings and relief grill in ceiling to recover heat from recessed lights during heating season. (Simple payback 12.1 years)

Destratification fans and fluorescent lights to replace the incandescent spotlights were determined not cost effective in 1986.

Few conservation measures were recommended, partly because the building was already an efficient structure and partly because the few measures available were very costly compared to their small savings potential.

As technology improves and costs go down, e.g., lighting measures, and as the cost of electricity escalates, the cost effectiveness increases. In 1988 this is happening. The price of fluorescent replacements is about one third of the estimates in 1986. As labor to change the bulbs is more costly, the fewer changes of fluorescents becomes more valuable. A 13 percent electric rate increase is proposed for 1989 by SCL.

Instead of wrapping the tank, a new efficient six-gallon tank could be installed. This would be large enough to meet the needs of this small office facility.

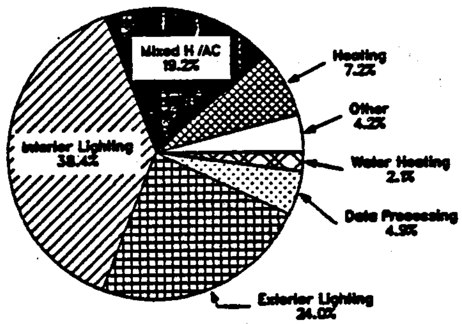
Another method of bringing the heat down from the ceiling would be ducts with fans. These would deliver the warm air directly to the floor where it is needed.

New buildings may have some incremental costs for improved double pane, low-E argon filled, sealed window units, which would provide a much better thermal value. But it would be too expensive at this time to replace the current double pane windows.

Enthapy controlled economizer would save energy. But at this time, probably not cost effective.

SITE 444 3/ 1/86 to 3/31/86

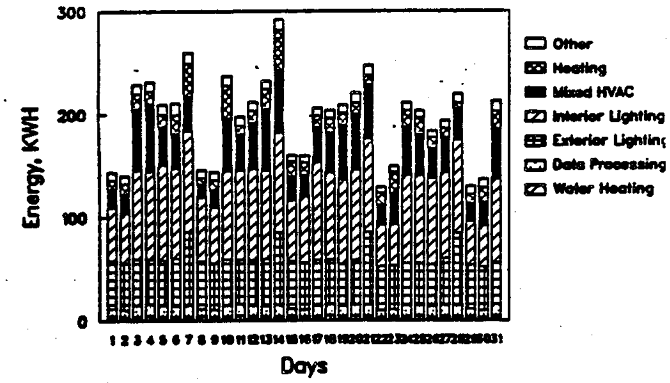
Share of Total Electricity Consumption 6,059 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

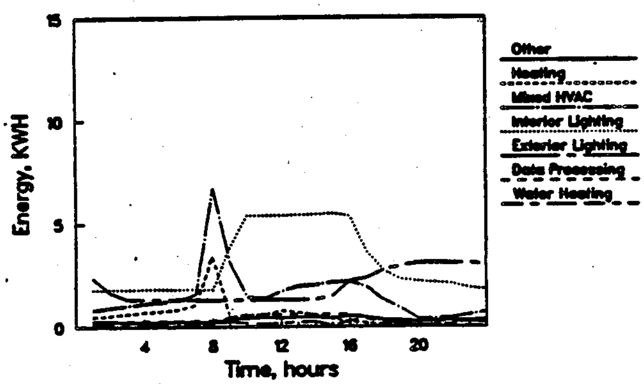
SITE 444 3/ 1/86 to 3/31/86

Total Electricity Consumption by End-Use *



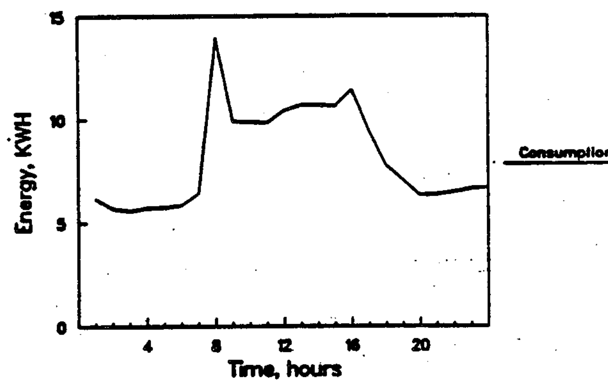
SITE 444 3/ 1/86 to 3/31/86

Average Daily Electricity End-Use Profile



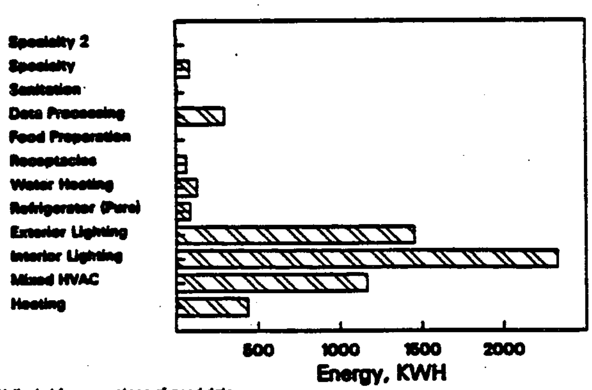
SITE 444 3/ 1/86 to 3/31/86

Average Daily Total Electricity Use



SITE 444 3/ 1/86 to 3/31/86

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID OFF301 | Year Built 1982

Primary Use Office - Pizza Place | Square Feet 3,425

Hours per week 40 - Office
79 restaurant

Yearly Consumption - Electrical - SCL Billing

	OFFICE		PIZZA
1985	18,706	+	147,200 = 48.4
1986	21,248	+	149,680 = 50.0
1987	14,807	+	149,680 = 48.0

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade, insulated
Walls	Concrete on brick - R13 insulation
Ceiling	Dropped ceiling or flat roof-R30 insulation
Windows	Clear double pane in metal frames
Sq. ft. Windows	249

BLDG. SYSTEMS

Heating	Heat pump with electric resistance back up.
Air conditioning	Heat pump
Hot water	One electric water heater
Refrigeration	Walk in cooler, freezer, retarden
Interior lights	7130 w fluorescent 900 w incandescent - 2.34 w/sq.ft.
Exterior lights	1350 incandescent, on photo cell.
Equipment I	oven
Equipment II	Food prep.

OFF301, built in 1982, is part of a small frame, brick veneer and concrete business complex adjoining an older frame building. It consists of a long narrow office and a fast food, take-out pizza restaurant. Across the back of the structure is a concrete storeroom. The entire ELCAP site is 3,425 sq.ft.

The walls have R13 insulation. The dropped ceilings of the office and of the restaurant have R30 insulation, the flat roof of the storeroom has R30. The concrete slab on grade floor has perimeter insulation. The windows are double pane galss in metal frames, the three small skylights in the storeroom are single glazed plastic. Inside lighting is fluorescent ceiling fixtures. Outside lighting is eight incandescent 150W flood lights controlled by a photo cell and an electric sign which is controlled manually.

The HVAC systems are thermostat controlled heat pumps for each business. The contain back up electric resistance heaters. A portable heater is sometimes used in the office.

There are some shared loads between the two businesses. The water heater and wall plug wires for the office are located in the pizza place. Some of the end use loads are mixed, e.g., office equipment and lights, or coffee maker and space heater, or interior and exterior lights. This causes some minor difficulty in getting a clean reading for some end uses. Major uses are measured separately.

AUDITOR'S OBSERVATIONS

The office space is now empty. The first of March 1987 the owner moved to a larger space on the other side of the old original structure. That space is not included in the ELCAP sample.

When this part of the buidlng was constructed it met the existing energy code requirements. Some modification could be made to provide more shading of the south side of the pizza restaurant. Asphalt surrounds the south and east sides. The oven produces tremendous heat. A heat pump for the water provide some more cooling with needed. However, the DHW demand is low, disposable supplies are used by the pizzaria, and the cost of the heat pump would be high.

The outside incandescent bulbs could be changed out to fluorescent flood lights or HPS lights. This would save over 2/3 of the kWh they are now using in these fixtures.

Bldg. ID OFG001 | Year Built 1975

Primary Use Office - Real Estate | Square Feet 4,800

Hours per week 69.5

Yearly Consumption - Electrical - SCL Billing

1985	132,360 kwhs	-	27.6 kwh/sq.ft.
1986	130,560 kwhs	-	27.2 kwh/sq.ft.
1987	127,560 kwhs	-	26.6 kwh/sq.ft.

Available End Use Data

NONE

BLDG. CHARATERISTICS

Floor	Concrete slab on grade.
Walls	Concrete, R4 insulation
Ceiling	Flat built up, R11 insulation
Windows	Single pane, bronze glass in metal frames
Sq. ft. windows	506

BLDG. SYSTEMS

Heating	2 gas furnaces
Air conditioning	2 direct expansion air conditioners
Hot water	20 gal. electric water heater
Rerigeration	Small
Interior lights	15,040 w fluorescent 1,800 w incandescent - 3.5 w/sq.ft
Exterior lights	2,500 watts fluorescent) on 1,000 watts HID) photocell
Equipment I	Office equipment
Equipment II	--

OFG001 is a small branch office of a large real estate firm. The 4,800 sq.ft. concrete building was built in 1975. It is off the freeway at a busy intersection. There is a small private parking lot on the west side of the building. The surrounding neighborhood has become more and more congested, the street has been widened and the building's outside space has become public space.

There have been no major changes in the building. The colors, decorations and lighting are the same as when built. The front corner with floor to ceiling, bronze, single, pane windows on two sides and a fake fireplace on another, has been arranged to be a pleasant reception area. A homey touch has been added with an oriental carpet, a couch, chairs and an antique side board with a table lamp. Track lights on each side do not highlight the objects intended as they have been moved by changing bulbs or dusting the fixtures. Next to the waiting area is a small, rather dark conference room. There is also a larger conference room with windows.

The reception desk separates the reception area from the large main office where the twenty or so agents have their desks. The lighting is poor, consisting of recessed fluorescent fixtures with various color rendition bulbs which are covered with plastic diffusers.

The manager says the building is to be remodeled sometime in the spring or summer of 1989. This would be a great opportunity to have the lights changed. He is not sure what the parent company is planning.

At the back of this large area are the restrooms and a small kitchen - lounge area for the employees.

The concrete walls have one inch of rigid insulation and are finished on the inside with gypsum wall board. The flat built up roof has three inches of batt insulation.

The HVAC system has two gas furnaces and two electric, direct expansion air conditioners. Almost all of the lights are 40 watt fluorescent ceiling lights, 15,040 watts, and 1,800 watts of incandescent lightings. The hot water is supplied by a 20 gallon electric water heater.

AUDITOR'S OBSERVATIONS

At the time the building is remodeled double pane glass could be used in the windows which surrounds the waiting area. While the R value of the structure is not high any retrofit of the ceiling, walls or floor would be expensive and the pay back long as the building is mostly a daytime building.

The lighting is not satisfactory. Energy efficient fixtures and lamps and reconfiguration of the lighting would be a great improvement, aesthetically and with good energy savings for the lighting. This would also save on the summer cooling load. The gas heat load in the winter would be increased some.

It is doubtful there is ever any need for 20 gallons of hot water. However, a 20 gallon water heater is more efficient than the 52 or 66 gallon heater often seen in offices. When it is time to replace the water heater, a six gallon or instantaneous water heater should be considered.

Bldg. ID OFG101

Year Built 1926

Primary Use Office

Square Feet 14,097 conditioned
14,552 unconditioned
28,649 Total

Hours per week 54 hrs. (Jan. through April 15th)
48 hrs. (April 16th through December)

Yearly Consumption - Electrical

1985 217,620 - 15.4 kwhs/sq.ft.
1986 214,020 - 15.2 kwhs/sq.ft.
1987 224,820 - 15.9 kwhs/sq.ft.

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete basement, concrete cantilivered.
Walls	Concrete with R-11 insulation.
Ceiling	Concrete, built up roof, no insulation.
Windows	Bronze tinted, single pane in metal frames.
Sq. ft. windows	2270 sq.ft.

BLDG. SYSTEMS

Heating	Gas fired hot water boiler.
Air conditioning	Chiller
Hot water	Gas water heater
Refrigeration	--
Interior lights	25,340w fluorescent 9,266w incandescent - 1.21w/sq.ft.
Exterior lights	1,760w fluorescent 580w incandescent 225w HPS
Equipment I	Office equipment
Equipment II	Photography & Printing Elevator

OFG101 is a three story concrete building with a basement. 75% of the basement level and of the first floor is an open air parking garage. The building was originally built in 1926, completely renovated in 1963 and has had various minor modification since then as tenants move in and out. An energy management system was added to the HVAC system in 1985. In 1987 a few interior walls on the 3rd floor were removed to provide a more open space for the existing tenant. Three more fluorescent ceiling fixtures were added. There has been a gradual increase in the number of computers, adding machines and copiers. Most of the tenants are financial or insurance firms with heavy use of office equipment.

The concrete walls have R-11 insulation and are finished on the inside with gypsum wall board. The flat roof is concrete with built up roofing, no insulation. The concrete floors have no insulation. Windows are single pane, bronze tinted glass in metal frames.

930 sq.ft. of the basement extends under the front side walk and contains storage space and part of the mechanical room. The other 940 sq.ft. of basement contain the rest of the mechanical room, the stairs and elevator, the telephone room and electrical room.

The first floor houses a 1061 sq.ft. financial institution and 845 sq.ft. of common area. Above this is 1866 sq.ft. mezzanine level. The rest of the floor is exposed to the parking area.

The 2nd and 3rd floors are 6480 sq.ft. each and are completely occupied by offices and common areas. On the south side of the building all but the top two floors have a common wall with the discount store to the south. However, most of this is not heated area but garage wall.

Most of the tenants occupy their areas from Monday through Friday about 8 or 8:30 am to 5 or 5:30 pm. The 3rd floor tenant is also open on Saturdays from 9 am to 3 pm during tax season, January through April 15th.

The building is heated by a gas fired hot water boiler and cooled by a chiller run by electricity. The system has a temperature control economizer cycle. The domestic hot water is supplied by a 50 gallon gas water heater with a circulating pump.

Most of the lights in the storage rooms and mechanical rooms are incandescent. The rest rooms, kitchens and a few of the common areas have incandescent lights. The rest of the interior lights are recessed fluorescent ceiling lights. Exterior lights are fluorescent or HID. The garage lights are fluorescent.

AUDITOR'S OBSERVATIONS

There is no insulation in the ceiling or floor. At time of re-roof exterior insulation could be added. This should decrease the heating and cooling loads. The underfloor would be more difficult & more expensive to insulate and would not save as much as the ceiling insulation. The single pane windows are bronze tint which helps keep down the solar gain in the summer, but also in the winter. Moveable window covering such as draperies or mini blinds would give added control to the occupants. Double or triple pane windows would be very expensive and probably not cost effective in this day time use building.

Lighting retrofit presents opportunity for savings. Incandescent lights in kitchens and rest rooms could be changed to efficient fluorescent lights. The incandescents in the mechanical rooms are turned on infrequently and it would not be cost effective to change them. Motion sensors in room with frequent in and out traffic might be considered. Efficient ballasts and fluorescent tubes could be used for the major lighting inside the building. HPS fixtures in the garage and in the stairwells would be more efficient and improve the light levels thus increasing security in those areas.

The building maintenance person is very concientious about "his" building and sometimes feels it is hard to convince the owners to spend the money for energy efficiency. Appearance, tenant comfort and satisfaction are their first concerns.

Bldg. ID OFG102 Year Built 1976

Primary Use Office Square Feet 9700

Hours per week 50

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985	309,840	31.9	NONE
1986	226,080	23.3	
1987	230,040	23.7	

BLDG. CHARACTERISTICS

Floor	Below grade concrete no insulation and wood frame R20 insulation.
Walls	Below grade concrete no insulation and wood frame R11 insulation.
Ceiling	Attic R20 insulation
Windows	Clear single pane, metal frames.
Sq. ft. windows	1205

BLDG. SYSTEMS

Heating	Packaged HVAC units.
Air conditioning	Direct expansion AC.
Hot water	40 gallon electric water heater
Refrigeration	--
Interior lights	(At time of survey) 28,400 w fluorescent 8,625 w incandescent - 3.8 w/sq.ft.
Exterior lights	2,840 w were incandescent & fluorescent. In 1986 were replaced with HPS (see reduction in consumption)
Equipment I	--
Equipment II	--

OFG102 is a building which has been studied by both SCL in the Commercial Hourly End Use Study (CHEUS) and by Pacific Northwest Laboratories in ELCAP.

The two story building with a small ground level entrance, mechanical room and elevator just off the parking level was built in 1976. The owner occupant, an architect from still occupies the large office on the first level above the parking area. The building is one of the newer Northwest style buildings which are gradually replacing the older apartments, houses and small businesses along a busy street. It is located just north of the downtown business center. The wood sided walls have 3 inches of batt insulation, the flat roof has six inches of batt insulation above the 3 foot high truss space. Below this is an acoustical tile, dropped ceiling. The floor above the parking area has six inches of batt insulation. The wood frame windows are single pane as are the store front doors to the small balconies on the west side of the building.

The HVAC system has four packaged HVAC units with four duct heaters. It is a single duct, constant volume system with eight heat rejection fans and four supply/ventilation fans. Air supply is controlled by each tenant's thermostat. Interior lights are recessed fluorescent ceiling lights. Exterior lights were originally incandescent but are now HPS.

Most of the tenants, which include the architect, a building supply firm, a consulting engineer and a labor union have minimal equipment such as typewriters, computers and a few coffee pots. There are two electric resistance heaters in the entrance-elevator lobby. Hot water is supplied by a 40 gallons electric water heater.

When the building was visited in march 1988 the labor union had been there a few months. An outside architect had redesigned the space for their use. Glass cubicles with no doors line the west window wall. The glass extends to the ceiling. There are no air vents in these cubicles. The thermostat for the air conditioning and for the heat is located in one of these spaces. A floor to ceiling room divider containing a storage closet was built at an angle near the back of the room. This structure covers half of a supply vent, providing a very well conditioned closet while forcing such a blast of air out the other side of the vent that the receptionist sitting below has now covered the rest of the vent in self defense.

The small conference room, constructed for a previous tenant had the supply vents block by sound equipment in the ducts. The addition of 75 watt track lights improved the lighting but raises the temperature. Controlling the temperature in any of the spaces will be difficult. It will be almost impossible to make it comfortable for everyone unless some of the barriers interfering with the air flow and with the controlling thermostat have been removed.

AUDITOR'S OBSERVATIONS

One problem is the heat build up from the west facing windows. There are sheer curtains which can help control the solar gains. People in chairs next to the windows may feel cold in the winter as the cold air drops down the window surface, creating a draft.

Reflective film could help cut down some of the solar gain. Double pane windows would make the area comfortable in the winter but would be expensive. In a day time building the pay back time would be long.

The HVAC system needs to be balanced to make sure dampers are operating properly, air flow is adequate in all ducts and there are no obstructions preventing proper function.

Since there is only one meter for the building it is difficult to determine individual consumption by each tenant. Even the ELCAP metering will not answer this questions as HVAC is a single system, each office is a different size and there is little control over the type of equipment each tenant uses.

Changes made in 1986 through the CHESU program at Seattle City Light resulted in the following findings, from the CHEUS report.

Office #2 - A variety of lighting and HVAC retrofits were installed in this small, all-electric office building. The retrofits included connecting parking garage lights to a timeclock and photocell, delamping of the interior light, replacement of outside air dampers, motors, and economizer controls, installation of an electronic time-clock, and changing heating and cooling setpoints. Submetered data were available for the HVAC system, interior lights, exterior lights, elevators and miscellaneous uses. Electricity use declined 29%, almost exactly reaching the predicted savings of 30% HVAC, interior, and exterior lighting savings were slightly less than predicted; miscellaneous use unexpectedly decreased. SCL weather-corrected the HVAC usage by correlating it with daily average temperatures; this correction would reduce whole-building savings to 11%. The local payback time was five years.

Bldg. ID OFG301 Year Built 1983

Primary Use Office Square Feet ~~77,964~~ 7796

Hours per week 45

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985	135,040	162,556 - 20.9 kwh/sq.ft.	NONE
1986	132,040	149,753 - 19.2 kwh/sq.ft.	
1987	124,080	137,215 - 17.6 kwh/sq.ft.	

BLDG. CHARACTERISTICS

Floors	Slab on grade
Walls	R11, brick, wood frame
Ceiling	Flat, built up, R19, dropped ceiling
Windows	Clear, double pane, metal frames
Sq.ft. windows	4295

BLDG. SYSTEMS

Heating	7 air source HP
Air conditioning	3 air source heat pumps, electric resistance
Hot water	5 gallon electric & 40 gallon electric back up
Refrigeration	--
Interior lights	14,480 w fluorescent 1,650 w incandescent - 2.06 w/sq.ft.
Exterior lights	2,100w incandescent, on time clock
Equipment I	Office equipment
Equipment II	Small kitchen

OFG301 is a 7,796 sq.ft., two story, brick building located in an office park with several similar buildings. While the business names on the doors are different it is really two divisions of the same company. When built in 1983 it met the energy code in force. Above grade walls have R11 insulation, below grade have R19. The ceiling has R19 insulation. The clear windows are double pane in metal frames. As are so many buildings in Seattle, it is built into a hillside. This provides a level entry with parking just outside, on each floor. There is an inside stairway in the center of the building. The HVAC system is a constant volume, single duct system with seven heat pumps with electric resistance back up heat. DHW is furnished by one 5 gallon and one 40 gallon electric water heaters.

The insurance and real estate business requires several computers and other office equipment. Most of the work areas are in the main, open parts of each floor. There is a rest room at the center of the top floor which helps divide the space. Private offices are at the corners of the buidling. On the lower level there is the large room, and employee kitchen, rest rooms, a separate computer room and another smaller office. The light grey carpet, pink and grey furniture and light oak wood work help create a bright atmosphere.

AUDITOR'S OBSERVATIONS

Exterior lights are on a time clock. The 2,100w of incandescent lights could be changed to fluorescent or for even more savings to HPS. Since this is an office building there is not a high demand for hot water. When the original tanks were put in the 40 gallons could have been a much smaller tank, maybe five gallons like the other one. Timers for the DHW could turn the tanks off early Friday afternoon and not have them come on until early Monday morning. The five gallon tank could also be timed to turn off at night.

Without data it is difficult to determine the effect of weather on the HVAC system. The building was built after the energy code but perhaps more insulation could be added to the dropped ceiling. Other buidlng measures would not be indicated.

Bldg. ID OFG401

Year Built 1982

Primary Use Mixed-Office & restaurant

Square Feet 12,130

Hours per week Varies

Yearly Consumption - Electrical - SCL Billing

Available End Use Data

NONE

	Ice Cream		Restaurant		Checks		Hot Dogs		Photo		TOTAL	
1985	61,278	+	108,900	+	204,444	+	79,740	+	7,821	=	462,183	- 38.1 kwh/sq.ft.
1986	60,674	+	109,740	+	189,444	+	68,040	+	13,301	=	441,199	- 36.4 kwh/sq.ft.
1987	61,235	+	106,140	+	152,705	+	70,440	+	12,871	=	403,391	- 33.3 kwh/sq.ft.

BLDG. CHARACTERISTICS

Floor	Slab on grade concrete.
Walls	Concrete block & stucco R8 or R10 rigid insulation.
Ceiling	Flat roof, dropped ceiling with R30 insulation.
Windows	Clear or tinted double pane in metal frames.
Sq.ft. windows	2294 sq.ft. + 210 sq.ft. of glass doors.

BLDG. SYSTEM

Heating	Five heat pumps.
Air conditioning	Five heat pumps, plus direct expansion AC for computer room.
Hot water	--
Refrigeration	Central system plus smaller individual refrigerator-freezer
Interior lights	17,040w fluorescent 13,470w incandescent - 2.5w/sq.ft.
Exterior lights	1400w Mercury vapor - on time clock 200w HPS - on time clock 1800w fluorescent signs
Equipment I	Refrigeration
Equipment II	Food prep.
Equipment III	Office equipment

OFG401 is located on a very busy corner across the street from the most used park in the city. It is surrounded on the other sides by private homes and low rise apartment buildings. The first floor has a 1,056 sq.ft. gourmet ice cream store, a 972 sq.ft. hot dog restuarant, a 760 sq.ft. photo finishing store and a 2,253 sq.ft. full service, white table cloth restuarant. The photo shop is not included in the ELCAP monitoring but is included in total use for the building. A parking lot, landscaping and a side walk run along the west side of the buildng. At the back corner there is an enclosed stairwell and elevator leading to the second floor. When the original survey was completed the entire second floor was occupied by a check verification firm. They left and the area was divided into three spaces, one twice as large as each of the other two. A wall now forms a hallway along the kitchen and restrooms, creating another zone. The computer room walls were removed from the center of the area. A law firm occupies this largest space. A physical therapy clinic has moved into one of the smaller areas.

In April 1, 1988 the lawyer and P.T. clinic were fully operational. In June 1989 the third space was still unoccupied. The OFG classification fit half the buidling when the survey was done. But because of the busy restaurant, the hot dog place and the ice cream store the load is gong to look more like a restaurant. Refrigeration, food prep, venting and cooling will be significant. The 1982 concrete block and stucco building has R10 and R8 rigid insulation in the walls. The flat built up roof has a dropped ceiling with R30 insulation. The first floor is 13 ft. high, the second floor is 9 ft. The floor is concrete slab on grade. Windows are double pane, in metal frames. Those on the first floor are tinted, on the second floor they are clear. The first floor walls are almost entirely glass on the north, east and west sides. The second floor has four foot tall windows along the entire north and west sides, taking advantage of the views of the lake and park, but not exposed to the southern sun. There are a total of 2,294 sq.ft. of windows and 210 sq.ft. of glass doors.

The HVAC system has individual heat pumps with auxillary electric resistance duct heaters for each space. In addition there is a separate air conditioner for the previous computer room. The tenants also use portable heaters and fans. There are three space heaters in the dining room and two for the second floor. The elevator lobby has an electric resistance, fan driven, wall heater on the first floor.

The spaces on the first floor being monitored by ELCAP open at 11 or 11:30 am. The hot dog place closes at 7 pm, the ice cream shop at 11 pm weekdays and 12 midnight weekends. The full service restaurant is closed from 2 pm to 5:30 pm but there is employee activity during that time and they are again open from 5:30 - 10:30 pm.

The check verification business which was on the second floor had eight operation employees working 24 hours a day Tuesday through Friday, and from 7 am to 11 pm. Saturdays, Sundays and holidays. On Monday they started work at 6 am. Twenty administrative staff worked 8:30 am to 5:30 pm, Monday through Friday and were off Saturday, Sunday and holidays. With the new law office which has only 3-4 employees, and about the same number of clients at any one time and small amount of electric equipment we will see a very different schedule. The physical therapy office has a washer and dryer.

Each tenant has a DHW tank. Most are 50 gallon electric water heaters. The large restaurant has an 81 gallon gas water heater, a gas grill, fryer, plate warmer, range and oven, grill and oven. We do not have the consumption data for these but they certainly add heat to this electrically heated space.

AUDITOR'S OBSERVATIONS

The building was built after code so very few measures could be recommended. The first floor tenants do use awnings to help keep out the sun in the summer. Second floor tenants could add window coverings. The lighting levels are high and many incandescent recessed fixtures are used. These could be changed to fluorescent recessed lights.

Control of the HVAC system is the most important element is regulating energy use. The waste heat from the kitchen and the compressors might be reclaimed and used to heat water or for space heat.

Bldg. ID	OFG501	Year Built	1982
Primary Use	Office	Square Feet	126,715
Hours per week	50		

Yearly Consumption - Electrical - SCL Billing

1985 - --
1986 - 3,236,400 - 25.5 khws/sq.ft.
1987 - 3,161,250 - 24.9 kwhs/sq.ft

Available End Use Data

Nov. 1986 - May 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete, R-19 insulation
Ceiling	Concrete, R-19 insulation, built up roof
Windows	Green tinted glass in aluminum frames
Sq. ft. windows	Double pane - 20,275 sq.ft. Single pane - 1,920 sq.ft.

BLDG. SYSTEMS

Heating	Forced air electric resistance
Air conditioning	Direct expansion, with enthalpy economizer
Hot water	Several small electric heaters
Refrigeration	Minor
Interior lights	158,006w fluorescent > 18,984w incandescent > 1.4w/sq.ft.
Exterior lights	5,530w HPS 1,040w incandescent
Equipment I	Data processing
Equipment II	Office equipment

OFG501 is a five story, 126,715 sq. ft. office building with 16 tenants, the largest building in the ELCAP sample. It was built in 1982 in a large office park surrounded by parking areas. It has two oblong sections set a little off-center into a central lobby area. The 248 foot long elevations face north and south and the 93 foot long elevations face east and west. The hill has been excavated so some of the building is below the parking area and has garden spots along the sides. The floor is slab on grade with only a small section about two feet below grade. The walls are concrete with R19 insulation and finished with wallboard on the inside. There is a mechanical room penthouse on each of the two sections. The flat builtup roof has a concrete deck and R19 rigid insulation.

20,275 square feet of the windows are double pane, green tinted glass in aluminum frames. The windows wrap around the entire building on each floor, including the six rounded corners where there are 1,920 sq. ft. of single pane, green tinted, curved glass. There are draperies on all the windows. The single pane, glass entry doors equal 246 sq. ft. The exterior of the building is uniform on all four sides and is roughly half glass and half insulated wall.

The central lobby has entry doors on both the north and south sides. The elevators are on the east side of the lobby. On the first floor central hallways extend east and west to the outside doors. On the other floors the space is divided to meet individual tenants' needs. There is a stairwell on the west side of the lobby and one in the center of each of the two sections.

A small cafeteria is located on the first floor just off the lobby. The remainder of the building is occupied by a software company, insurance agencies, brokerage firms and other financial businesses. The ambiance of this "money" building is maintained with plush carpeting, an abundance of oak and polished brass, art work, exotic plants and many recessed incandescent ceiling fixtures.

The building has a central HVAC system for heating and cooling which has four air conditioning units with enthalpy controls and electric resistance heaters with fans and air supply fans. Exhaust fans have been separated out under "ventilation."

158,000w of fluorescent tube ceiling fixtures is the main type of interior lighting. In addition there are 18,984w of incandescent lights, used mainly in the recessed cans in the lobby areas. Exterior lights are 5,530w of high pressure sodium lights on a photocell and 1,040w of incandescent lights in the entrance canopies.

Data:

Six months of data, from November 1986 through May 1987, are available for this site. In graphs #1 November through January look very similar in enduse share of consumption. As spring arrives, February through May, the consumption shares change. There is more demand for cooling and less for heat. The other loads remain fairly constant. From the billing history we know the total use is highest in warm summer weather and least in the mild spring weather. This building, with a large amount of constant ventilation is weather sensitive. This is seen even on individual days. March 4, 30 and 31 were above normal temperature days. The cooling load shows an increase on those days. March 1 and 16 were colder than normal and HVAC (heating) shows an increase, (Graph #2).

The hourly profiles, graph #3, show the HVAC running at night the entire six months. It then drops during the day when the interior lighting levels and occupancy are high. The supply air continues throughout the entire 24 hours as does the ventilation exhaust. Heating and cooling run at the same time. These graphs show interior lights start to increase about 6 a.m. as the brokerage firms open early and start to decrease about 4 p.m.

Auditor's Observations and Recommendations:

Appearance and comfort are very important in this builidng. Any recommendations for changes need to take this into consideration.

The opportunities for electrical savings in a newer building are not as great as in older buildings but there are some fairly simple measures which would be effective.

1. The 75w incandescent spot lights in the lobby areas could be converted to 18w fluorescent lights and provide more lumens. These lights are on 24 hours a day so the savings would be greater than for lights on only 10 hours a day.

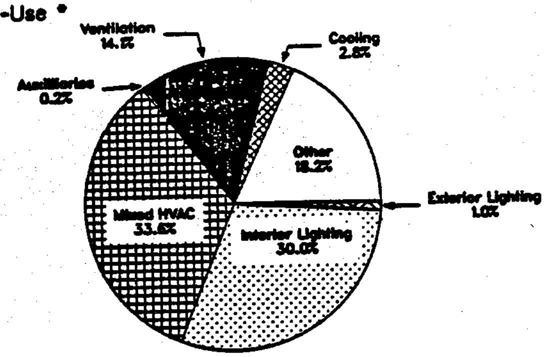
2. The HVAC heating and the cooling systems need to be reprogrammed for the weekends and nights. The consumption patterns indicate that they are trying to maintain a constant temperature all the time. A few people occasionally work off hours. But from midnight to 5 a.m. and on Sundays the system could probably be set back without any discomfort to the tenants. When a tenant space is vacant the systems should be set back for that space.

3. In the cold weather the draperies should be closed at night. In the hot weather they should be closed during the day on those windows where the sun shines in directly. May not be popular with tenants who want "views."

4. The single pane windows, which are 8 ft. x 8 ft. of curved glass on the corners would be almost impossible to insulate. Tenants should take care not to place employees immediately next to them as the convection currents in the winter could be uncomfortable and generate requests for higher indoor temperatures.

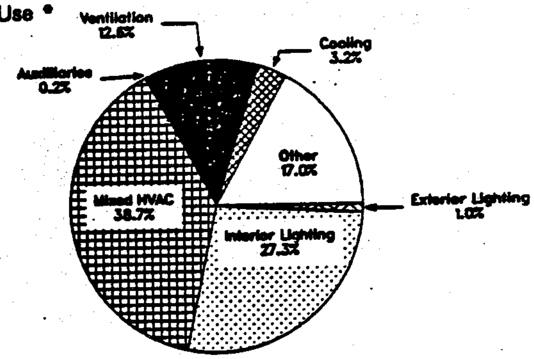
SITE 697 11/ 1/86 to 11/30/86

Share of Total Electricity Consumption 229,236 KWH
by End-Use *



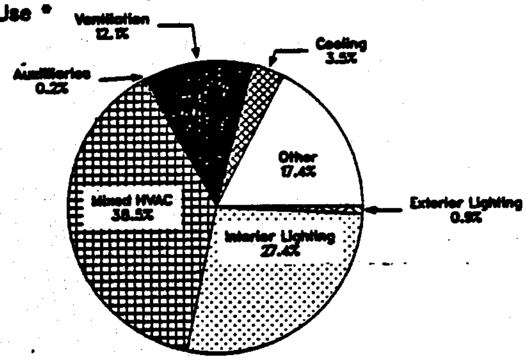
SITE 697 12/ 1/86 to 12/31/86

Share of Total Electricity Consumption 252,050 KWH
by End-Use *



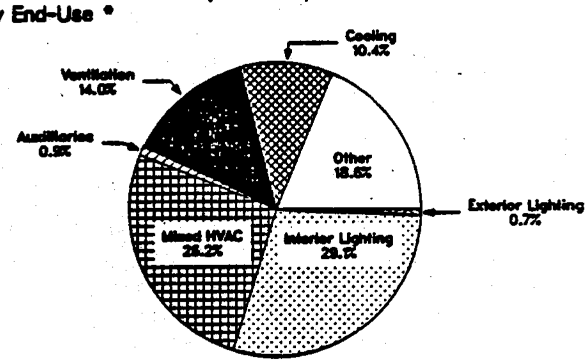
SITE 697 1/ 1/87 to 1/31/87

Share of Total Electricity Consumption 260,005 KWH
by End-Use *



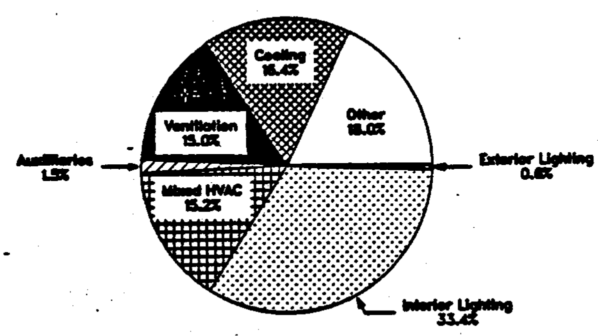
SITE 697 3/ 1/87 to 3/31/87

Share of Total Electricity Consumption 254,444 KWH
by End-Use *



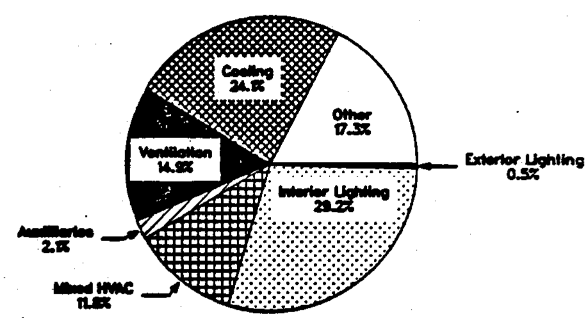
SITE 697 4/ 1/87 to 4/30/87

Share of Total Electricity Consumption 258,517 KWH
by End-Use *



SITE 697 5/ 1/87 to 5/31/87

Share of Total Electricity Consumption 265,495 KWH
by End-Use *

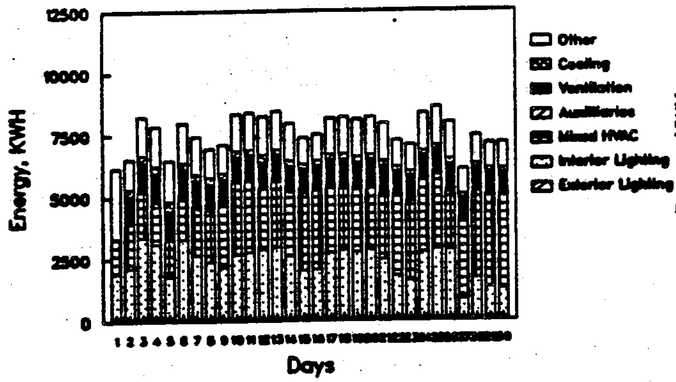


* Adjusted for percentage of good data
Sample size = 1

ELCAP

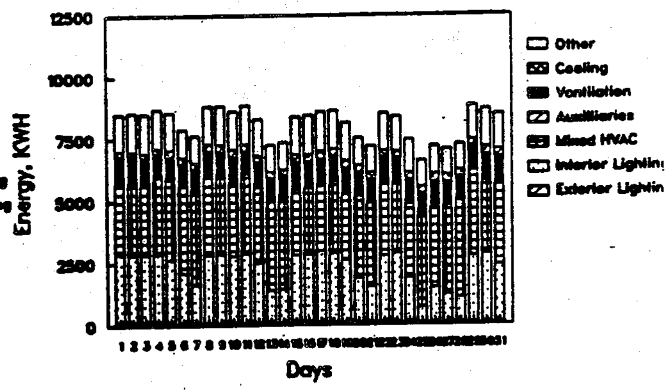
SITE 697 11/ 1/86 to 11/30/86

Total Electricity Consumption by End-Use *



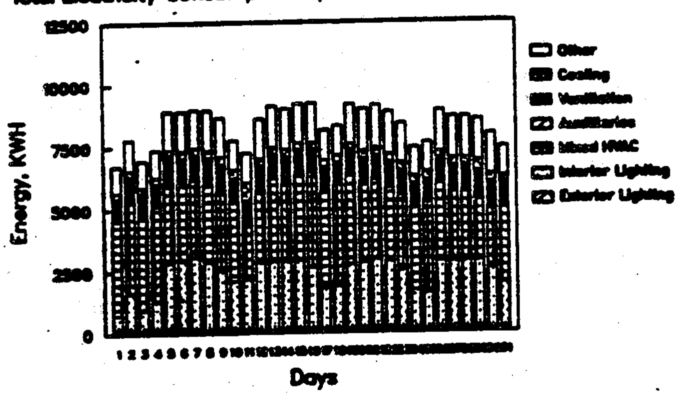
SITE 697 12/ 1/86 to 12/31/86

Total Electricity Consumption by End-Use *



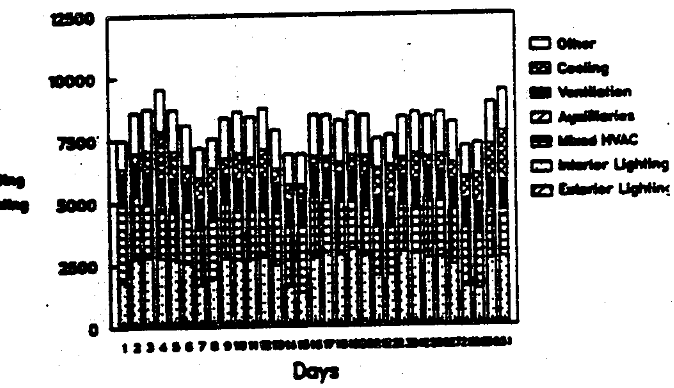
SITE 697 1/ 1/87 to 1/31/87

Total Electricity Consumption by End-Use *



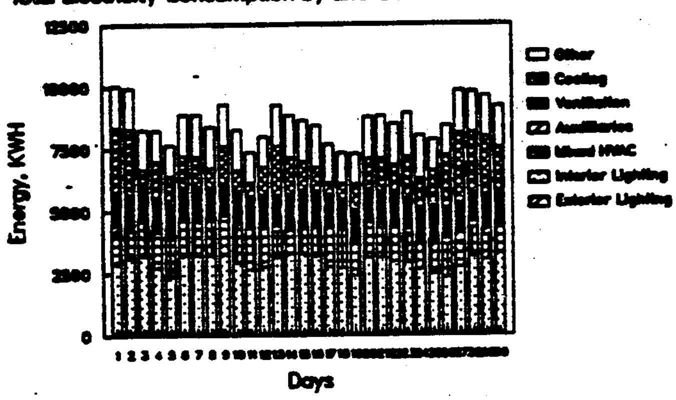
SITE 697 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



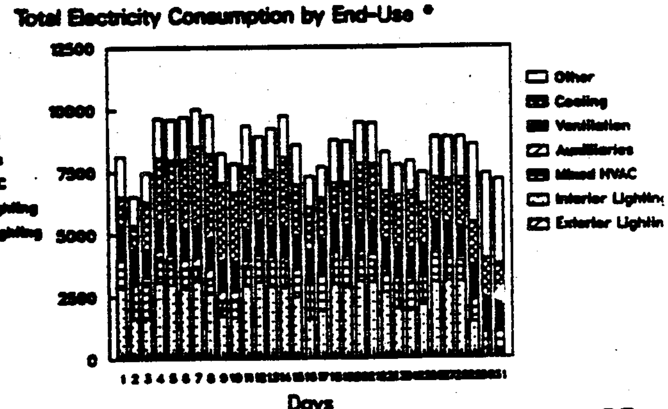
SITE 697 4/ 1/87 to 4/30/87

Total Electricity Consumption by End-Use *



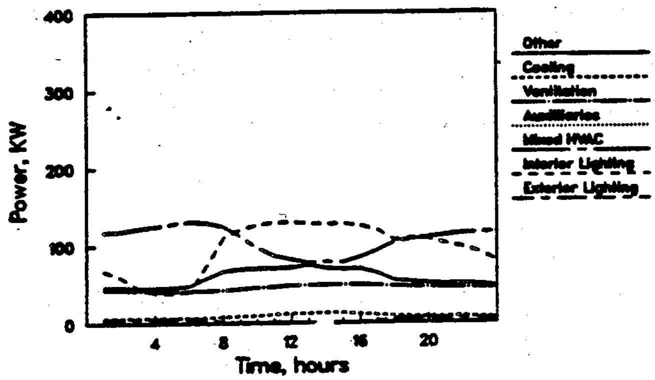
SITE 697 5/ 1/87 to 5/31/87

Total Electricity Consumption by End-Use *



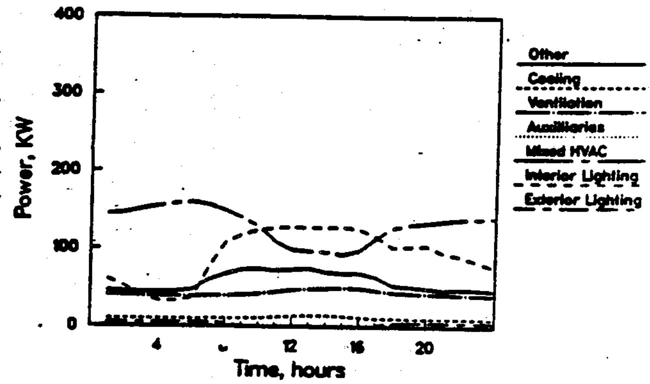
SITE 697 11/ 1/86 to 11/30/86

Average Daily Electricity End-Use Profile



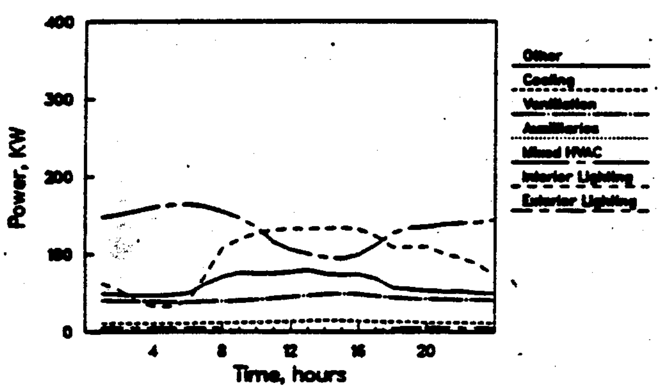
SITE 697 12/ 1/86 to 12/31/86

Average Daily Electricity End-Use Profile



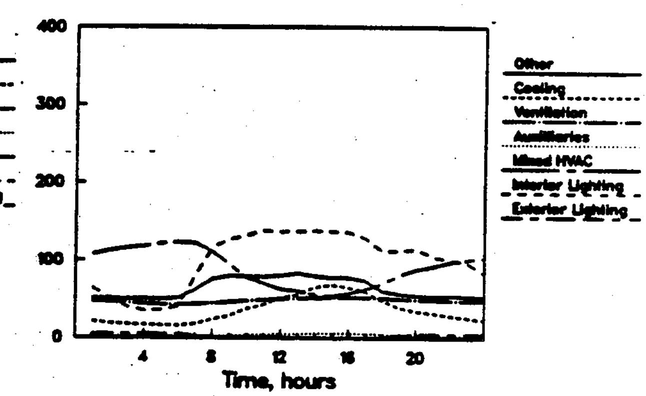
SITE 697 1/ 1/87 to 1/31/87

Average Daily Electricity End-Use Profile



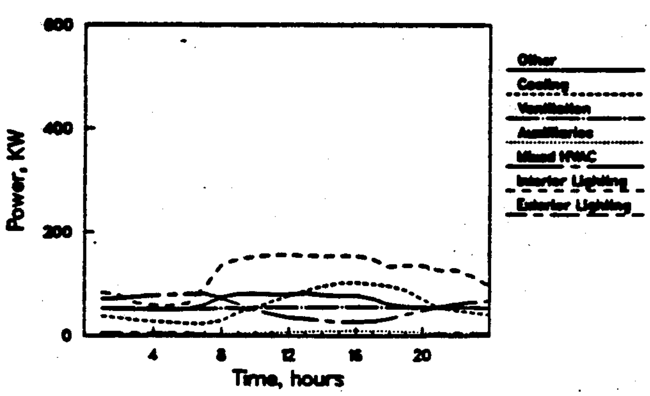
SITE 697 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



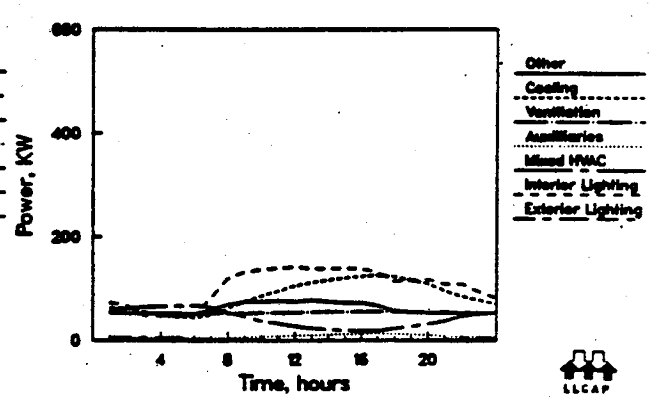
SITE 697 4/ 1/87 to 4/30/87

Average Daily Electricity End-Use Profile



SITE 697 5/ 1/87 to 5/31/87

Average Daily Electricity End-Use Profile



LLCAP

Bldg. ID OFM103 Year Built 1974

Primary Use Medical Office Square Feet 59,831

Hours per week Restaurant - 106
Offices - 40 to 60

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985	1,421,280	23.8 kwh/sq.ft.	NONE
1986	1,613,880	27.0 kwh/sq.ft.	
1987	1,839,960	30.8 kwh/sq.ft.	

BLDG. CHARACTERISTICS

Floor	50% concrete basement, 50% concrete slab on grade.
Walls	75% concrete with R-11 insulation, 25% metal with R-4 insulation.
Ceiling	Concrete, R-8 insulation
Windows	Clear single pane in metal frames.
Sq. Ft. windows	6576

BLDG. SYSTEMS

Heating	Steam from boiler in adjacent building.
Air conditioning	Central chiller. Restaurant also has 2 heat pumps.
Hot water	Central boiler, Circulating pump.
Refrigeration	Compressor and other refrigeration for restaurant.
Interior lights	81,357 w fluorescent 61,747 w incandescent - 2.39 w/sq.ft.
Exterior lights	3040 w fluorescent 850 w incandescent
Equipment I	Office equipment
Equipment II	Medical equipment

OFM103 is an oblong four story medical office building adjacent to a community hospital. An underground tunnel connects the buildings at the basement level. Like so many office building this one contains some retail space on the first floor, a 2806 sq.ft. restaurant, 1254 sq.ft. pharmacy, a 105 sq.ft. equipment rental shop and a 277 sq.ft. hair salon. The half basement has mechanical rooms, storage and exercise rooms, squash court and showers. The other half is slab on grade.

The rest of the building is dedicated to doctors' offices, exam rooms, waiting areas, labs and x-ray rooms. Each suite has been individually configured to meet the needs of each practitioner. The central core of the building is 106 ft. long by 22 ft. wide with elevators, rest rooms, mechanical rooms and stairwells in the center, surrounded by 6 ft. wide hallways. A large mechanical room is on the roof.

In the fall of 1988 the equipment rental store will become an office area for two physicians. The amount of electrical equipment and the number of people will increase in this area. The building is usually fully occupied and vacancies do not last long.

The concrete building was finished in 1974. The concrete walls are insulated with R-11 insulation and finished with wall board on the inside. Half of the wall space on the 1st floor is sheet metal panels with R-4 insulation, and half clear, single pane glass windows in metal frames. The single pane windows in the upper floors are smaller and occupy less wall space than in most buildings built at that time, 1753 sq.ft. total for the three upper floors vs. 4823 sq.ft. for the 1st floor.

Below grade concrete walls have no insulation. The eight inch concrete ceiling has a built up roof and R-8 rigid insulation.

Conditioning is supplied by steam from a gas fired boiler in the hospital, chilled water from a chiller in the office building, air dryers, supply and exhaust fans and circulating fan. The restaurant also has two air to air heat pumps with electric resistances back up, two heat rejection fans and two supply fans, as well as another exhaust fan.

Because the heavy demands of the restaurant are so different from the rest of the building the additional equipment is needed. Most of the heavy cooking equipment is gas fired. Food prep equipment & refrigeration is electric. Other loads in the building are the two elevators, and smaller loads such as light boxes for viewing x-rays, autoclaves, power dental chairs, EKG machines and other assorted medical equipment, computers and office equipment. The large load is the installed lights; mostly fluorescent tubes with a generous sprinkling of incandescent floor lamps in the waiting rooms, in the rest rooms and some hall areas.

Exterior light is provided by fluorescent lights at the entrances, for the signs and to light special architectural features and the flag on the roof.

Operations for all the buildings in the complex is managed by the one facilities' manager. He is knowledgeable about possible system savings and fights the battle of initial cost against future savings.

At the end of 1987 and beginning of 1988 the air handling system for the office building was not working properly, and so had to run all the time. This has now been corrected. The system is turned off at night and weekends. The next step is new mixer boxes with individual thermostats for each suite. These will be installed starting fall of 1988. This will enable the tenants to control the temperature in each of their spaces. The impact on energy use will be interesting.

OBSERVATIONS & RECOMMENDATIONS

In a building 14 years old which has had steady turnover, but high occupancy, the changes sort of evolve until the original configuration of spaces and the uses of those spaces take on a different appearance. One change has been the addition of more computers. While some new equipment may be more efficient than the old (a microwave oven instead of a toaster oven) there are just more things, as people expect more amenities.

There are several incandescent lights in this building which could be changed to fluorescent. The floor and table lamps in many waiting rooms are part of the decor and changing them to fluorescent might be resisted by the tenants, especially since they do not pay the electric bill. New lighting technology is providing increasingly efficient and attractive lighting.

Changing the windows is not recommended at this time. The small windows in the offices have shades which help control solar gains. The large windows in the restaurant contribute to heat loss in the winter and solar gain in the summer. Here tinted double pane windows might increase comfort levels, but would be an expensive measure.

Bldg. ID OFM301 Year Built 1982

Primary Use Medical office Square Feet 5128

Hours per week 50

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985	114,360	22.3 kwh/sq.ft.	NONE
1986	99,960	19.5 kwh/sq.ft.	
1987	114,885	22.4 kwh/sq.ft.	

BLDG. CHARACTERISTICS

Floor	Concrete over crawl space, R11 insulation
Walls	Wood frame R11 insulation
Ceiling	Flat built up roof, R30 insulation
Windows	Double pane, metal frame
Sq. ft. windows	1091

BLDG. SYSTEMS

Heating	Air to air heat pumps, electric resistance heaters
Air conditioning	Air to air heat pumps
Hot water	65 gallon electric water heater
Refrigeration	--
Interior lights	910 w fluorescent 10,120 w incandescent - 2.2 w/sq.ft.
Exterior lights	Incandescent and HID on timer on photo cell.
Equipment I	--
Equipment II	--

OFM301 was built in 1982. In January 1987 more office space was built in what was originally a 896 sq.ft. parking area under a cantilevered protion of the second floor. This building profile limits itself to the information for the original buidling. The new section is not included in the enduse monitoring but will add an extra, unaccounted load in the total consumption of the building after January 1987.

The attractive, two story, 5,128 sq.ft. stucco building faces west onto a busy street near a large university medical center. The central lobby is 20 feet high with a window wall and a glass door. The walls have R11 insulation and are finished on the inside with gypsum wall board. The flat, built up roof has R30 insulation and the concrete floor over crawl space has R11 insulation. The windows and skylights are clear, double pane glass in metal frames. The glass doors are single pane in metal frames.

HVAC is supplied by 5 heat pumps with backup resistance heaters. It is a single duct, constant volume, no economizer system. One heat pump serves just the two story common area lobby. Another serves the 325 sq.ft. conference room on the second floor. The other three heat pumps serve five offices each.

The main lobby is flooded with light from the large two story windows and from skylights in the ceiling above.

When the building was constructed in 1982 color corrected fluorescent lights in desireble shapes and configurations were not on the market. Most interior lights are incandescent, 100w track lights and table and floor lamps with 3-way incandescent bulbs. A pleasing ambiance is very important; a warm and friendly atmosphere is desired.

Exterior lights are incandescent and HID on a timer or a photo cell.

Most of the fifteen tenants are psychiatrist or other mental health professionals. The equipment in the buidlng is more like a general office than medical office. The offices vary in size from 126 sq.ft. to 285 sq.ft. The main reception desk in the lobby waiting area serves all the tenants. The building is open for appointments from 8am to 6pm, with about ten employees and twenty-five patients in the building at anyone time. Occasionally therapists will come in early or stay late or come on the weekend.

AUDITOR'S OBSERVATIONS

With the new lighting products on the market the interior lighting effect could be maintained and even enhanced, using the new fluorescent bulbs.

An economizer control on the HVAC system and a variable speed drive might be considered for the HVAC system.

The building shell was built to energy code at the time and any modificiation at this time would not be cost effective.

Bldg. ID	OFM401	Year Built	1983
Primary Use	Medical Clinic	Square Feet	10,871
Hours per week	45		

Yearly Consumption - Electrical - SCL Billing

1985 - 166,080 - 15.3 kwhs/sq.ft.
1986 - 153,240 - 14.1 kwhs/sq.ft.
1987 - 152,280 - 14.0 kwhs/sq.ft.

Available End Use Data

January 1986

BLDG. CHARACTERISTICS

Floor	Wood over unvented concrete crawl Perimeter R-6 insulation
Walls	Wood frame - R-19
Ceiling	Mostly R-30, flat roof
Windows	Double pane, metal frame
Sq. ft. windows	901 square feet

BLDG. SYSTEMS

Heating	Air source heat pumps with electric resistance back up
Air conditioning	Air source heat pump
Hot water	120 gal. electric
Refrigeration	On receptacle load
Interior lights	Incandescent and fluorescent
Interior lights	18,130 w fluorescent 14,660 w incandescent - 3 w/sq.ft.
Exterior lights	High pressure sodium 3,740 w
Equipment I	Office equipment
Equipment II	Medical equipment

OFM401 was built in 1983 as a primary care outpatient clinic of a large Health Maintenance Organization. At that time construction of the one story square shaped building was state-of-the-art for thermal efficiency, lighting and HVAC.

The stucco walls have R-19 batt insulation. In the 9,659 square foot flat built-up roof there is R-30 batt insulation. The smaller 1,212 square foot flat roof above the center lobby area has R-13 rigid insulation. The exterior below grade walls have R-5.5 rigid insulation. The floor above the unconditioned crawl space has R-4.4 rigid perimeter insulation. An unconditioned 188 square foot mechanical room is located on the roof. HVAC is provided by six air-to-air heat pumps, exhaust fans and backup electric resistance heat coils in the system. Each serves separate zones and is individually controlled by thermostats in those zones. Electric radiant panels heat the rest rooms and file room. Electric resistance baseboards heat the entries. The combination of these systems can provide zone controlled heating or cooling in just the area needed.

All windows are double pane, either tinted or reflective glass, in metal frames. Those at eye level have individually controlled inside window coverings. The high windows, clerestory windows and skylights do not have any movable coverings.

Inside lighting is primarily fluorescent ceiling lighting. Some small areas, e.g., janitor's closet, control room, rest rooms and some table and floor lamps, decorative lighting, task lighting and exit lights are incandescent. Add them all together and lighting makes a significant load contribution. (3 watts per sq. ft.)

Outside lighting consists of 28 HID (High Intensity Discharge) lights in the soffit around the building, three incandescent lights in the entrance and five HPS (high pressure sodium) pole lights in the parking area. They are controlled by photocell. Security lighting is important as the clinic is located in a high crime area.

Medical equipment is used sporadically. Office equipment (typewriters, computers, etc.) is in fairly constant use during the day. Coffee makers and other kitchen appliances account for the remaining loads on the outlets throughout the clinic.

The building entrance faces west to a landscaped parking lot. A busy street is just beyond. As the vegetation matures it will provide more summer shading to the building and the parking lot. The majority of the windows are on this side of the building. Two sets of glass doors form a vestibule, giving an air lock entrance to the lobby. The clerestory windows around the raised, 20 foot high center lobby admit natural light to the lobby/waiting area. Offices, pharmacy and clinic areas surround this room. A short back hall leads to the back door on the east side. There are also exit doors on the north and south sides of the building.

Carpeting, comfortable furniture, subdued colors and a fish tank along with the short traffic patterns have a quieting effect on the busy clinic. There are five physicians plus clinic support staff and administrative staff for a total of 22 employees. They have between 75 to 100 patients visit a day. Family members also come along to these clinic visits. Other patients come in to pick up prescriptions at the pharmacy. This would mean about 250 people would come to the clinic building each day, averaging about 10-15 at any one time.

Data:

Graphs for the month of January 1986 show that lighting is the dominant load. Graph #1 HVAC and resistance heating combined are a large load. Some of the HVAC load is heat furnished by the heat pump. But much of it is venting and air circulation, a year round function. In the summer the cooling function of HVAC system would be working to overcome the heat produced by the high lighting levels in the building.

In graph #3 we see the step up of the HVAC system several hours before the clinic opens. The sharp peak in a winter month is caused by the demand for heat. The small radiant heat load does not come on until just before the clinic opens and remains constant until it closes. Both interior and exterior lights follow a very steady and predictable pattern. Water heating receptacles and "other" mimic the interior lighting and reflect clinic operation. On graph #2 we see a dramatic increase in the HVAC load on Mondays or the day after a holiday, the times when there was practically no HVAC load. The colder building (very little HVAC or lighting and reduced heat) requires more heat from the heat pump. Other variations in hot water, interior lighting and "other" reflect levels of work load.

A summertime set of graphs would be very useful in comparing loads.

Auditor's Observations and Recommendations:

The building is new, meeting the 1983 Energy Code requirements.

The building is only used during the day. Clinic hours are 8:30 a.m. to 5:30 p.m. Monday through Friday. Therefore shell measures do not have as great an impact on the heating load as a building used 24 hours a day. Cooling could be of more concern in warm weather because of the high occupancy, high natural light levels and frequent door opening as well as the heat generated by the electric lights.

1. Several incandescent lights are on all day or all night. They could be changed to fluorescent lights. Selective switching and dimming could turn off some lighting when daylight is sufficient to illuminate areas. Constantly new innovations in light bulbs, fixtures and controls would make this possible.

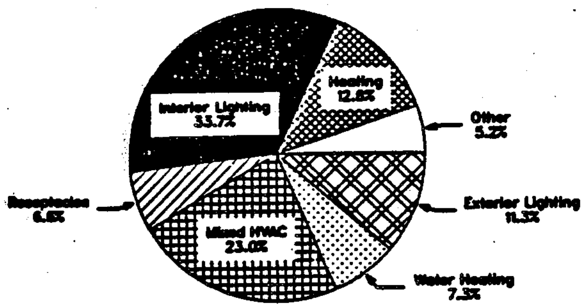
2. With lower wattage light fixtures the winter heating load would be increased, as the lights are equal to 27 - 1200w heaters on all the time, but the summer cooling would be decreased, a trade off, so efficient lights would effect a real savings. Areas lit infrequently or switched on and off frequently should be left incandescent.

3. The building has zone controlled conditioning. All employees should be instructed on how to best utilize the systems in their areas for maximum comfort and conservation.

4. Setting the heat pump to turn on earlier on Monday mornings could decrease the resistance heat needed for morning warm-up and lower the demand charges.

SITE 456 1/ 1/86 to 1/31/86

Share of Total Electricity Consumption 17,770 KWH by End-Use *



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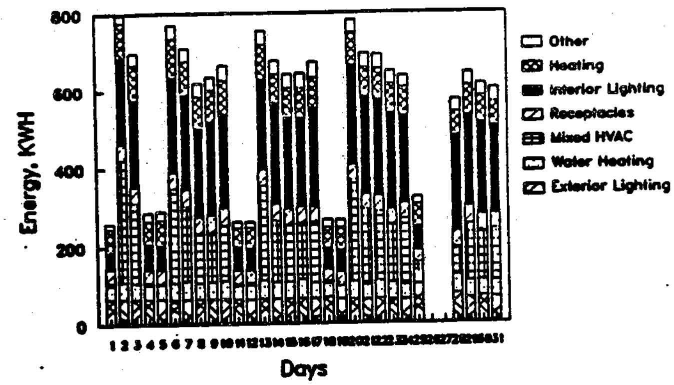
Sample size = 1

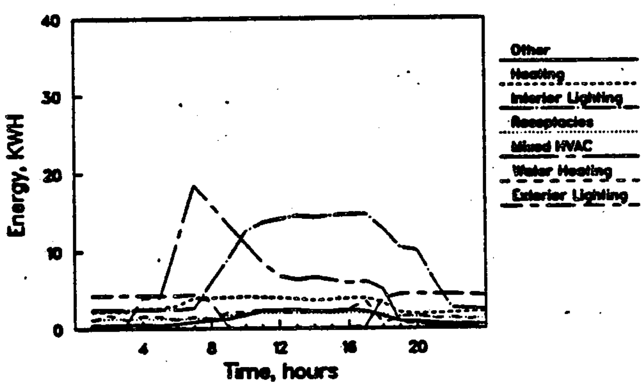
SITE 456 1/ 1/86 to 1/31/86

Total Electricity Consumption by End-Use *



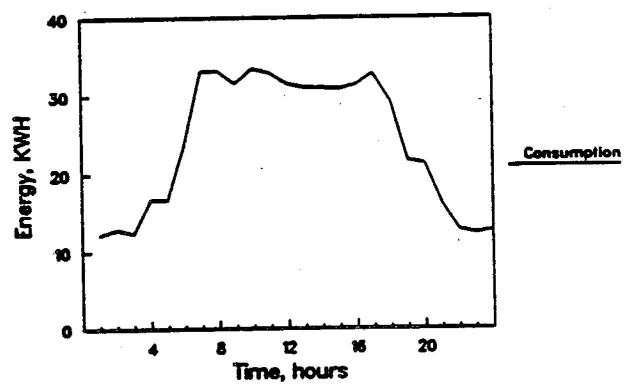
SITE 456 1/ 1/86 to 1/31/86

Average Daily Electricity End-Use Profile



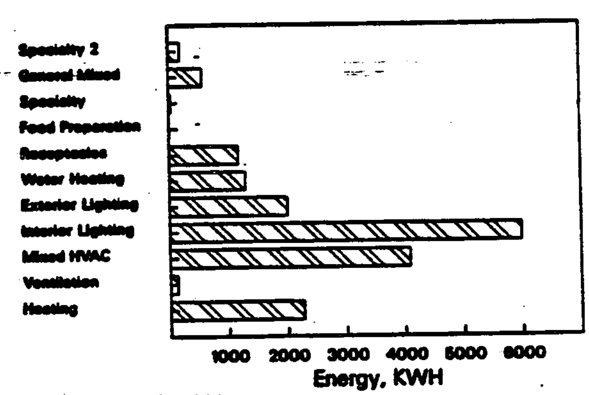
SITE 456 1/ 1/86 to 1/31/86

Average Daily Total Electricity Use



SITE 456 1/ 1/86 to 1/31/86

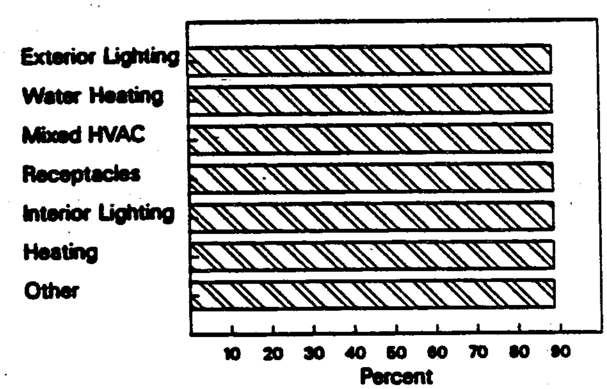
Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

SITE 456 1/ 1/86 to 1/31/86

Percentage of Good Data



* Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID OFM402 Year Built 1983

Primary Use Medical Offices Square Feet 30,305

Hours per week 55

Yearly Consumption - Electrical - SCL Billing			Available End Use Data
1985	721,920	23.8 kwhs/sq. ft.	4 quarters
1986	781,920	25.8 kwhs/sq. ft.	2nd-1988 thru 1st-1989
1987	746,160	24.6 kwhs/sq. ft.	

BLDG. CHARACTERISTICS

Floors	Slab on grade-concrete
Walls	Wood frame - R13 insulation
Ceiling	Built up roof - R30 insulation
Windows	Double pane - clear
Sq. ft. windows	5,595

BLDG. SYSTEMS

Heating	Variable volume: Single duct, Electric resistance, fan induction
Air conditioning	Direct expansion
Hot water	120 gallon electric heater plus several "instant" electric heaters.
Refrigeration	several small loads
Interior lights	36,337 w fluorescent 45,976 w incandescent - 2.7 w/sq.ft.
Exterior lights	3670w - HPS) 1650w - incandescent) On time clock. 3400w - fluorescent)
Equipment I	medical
Equipment II	office

OFM402, built in 1983 is a square concrete building with open parking under part of the building. The "basement" is 1,121 sq.ft. of entry hall, elevator, mechanical, electrical and storage rooms.

The three floors above this are each 9,728 sq.ft. of office spaces, each tailored and decorated to suit each tenant's needs. Three medical offices and a small branch bank occupy the first floor. There is a large entry with double glass doors and a lobby area leading to the elevators.

The carpeting and furnishings are color coordinated in mauves and greys. The atmosphere is quiet and subdued with indirect lighting on the walls. The entire second floor is occupied by an allergy-asthma clinic. The third floor has four square shaped offices. On the roof there is a 1,365 sq.ft. penthouse containing a large conference room, restrooms and a small lunch room. This part of the building is not open to the patients but used by the tenants for special meetings or for break times.

The time of greatest occupancy is from about 8 am to 5:30 pm. The bank opens at 9:30 am and some of the medical offices will occassionaly see patients as early as 6 am and sometimes as late as 7 pm. There are usually about 70 employees in the building and about 64 patients/customers.

The building components and systems met the 1980 energy code when built. The walls have R11 batt insulation. The exterior underfloor, over the parking area, has R11 insulation. The flat, built up roof has R30 insulation. The 5,595 sq.ft. of windows are clear, double pane glass in metal frames. Mini blinds are used for view and sun control.

The central HVAC system is variable volume, electric resistance, terminal reheat, and direct expansion air conditioning. The bank has installed electric radiant heat panels in the teller area. Some of the offices have portable electric space heaters.

While this building has been fairly stable the complex where it is located has changed. The small two story building just south of it has been torn down (1987), and a two level parking facility built in its place. To the west there is now another three story building comparable to the ELCAP building. A concrete plaza has been built between the two buildings and extends to the top level of the parking garage. These changes affect the solar exposure of the building, allow a little more on the south and a considerable lesser amount on the west.

DATA

The graphs for the four quarters show the different summer and winter patterns of consumption and of load shape. In the winter the large load is heating; with an early morning warm up peak. In the summer the large load is cooling and the peak is late in the day. The other loads remain fairly consistent year around.

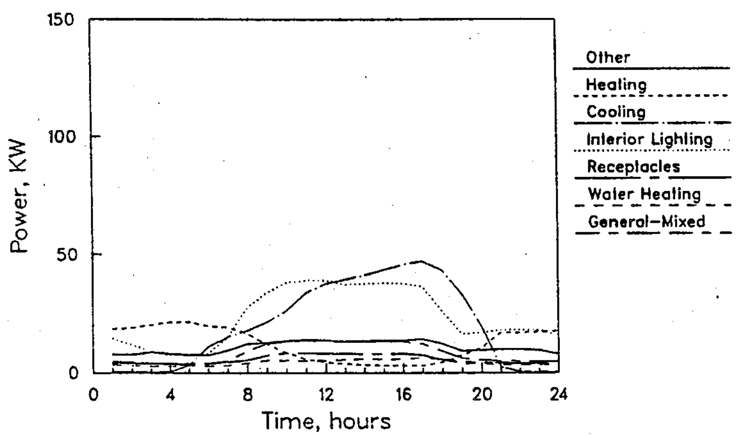
OBSERVATIONS

The addition of radiant panels and portable heaters would indicate that the heating system is not sufficient for the building. Attention should be given to the balancing of the system and appropriate adjustments should be made.

The many incandescent lights could be changed to fluorescent. Shell measures would not be recommended.

SITE 717 2nd Quarter 1988

Average Daily Electricity End-Use Profile



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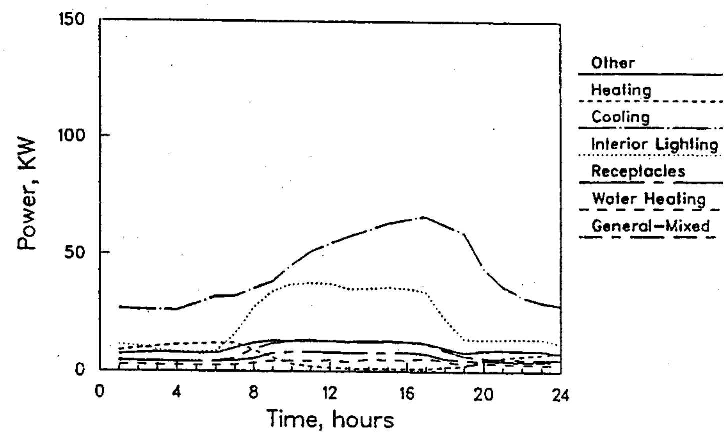
SITE 717 3rd Quarter 1988

Average Daily Electricity End-Use Profile



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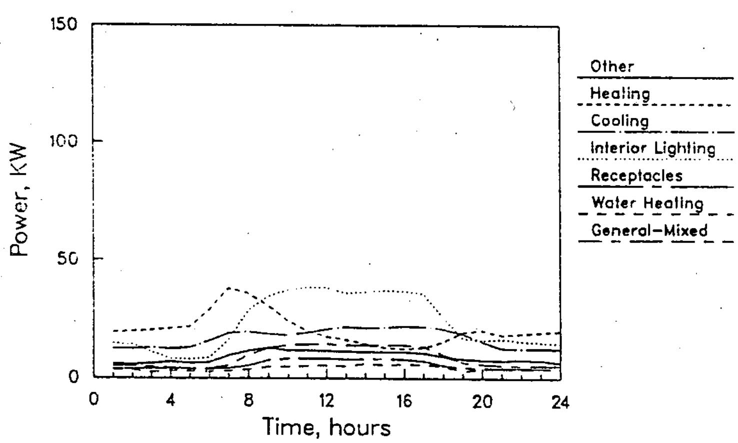
SITE 717 4th Quarter 1988

Average Daily Electricity End-Use Profile



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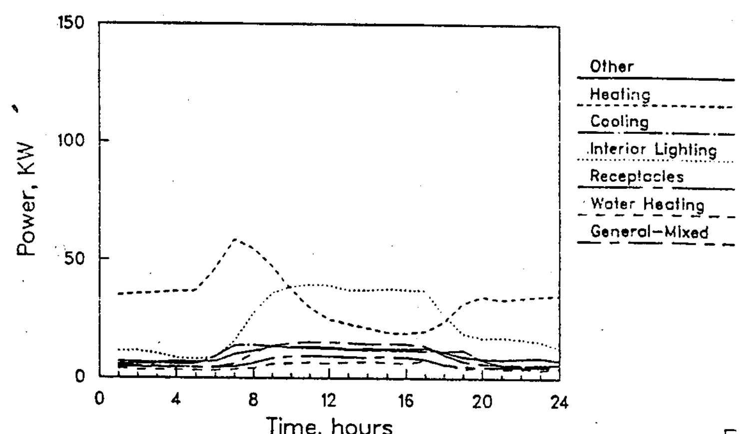
SITE 717 1st Quarter 1989

Average Daily Electricity End-Use Profile



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Bldg. ID OFP401 Year Built 1984

Primary Use Police station. Square Feet 16,372

Hours per week 168

Yearly Consumption - Electrical - SCL Billing

1985 - 425,040 kwhs - 26.0 kwhs/sq.ft.
1986 - 405,120 kwhs - 24.7 kwhs/sq.ft.
1987 - 407,760 kwhs - 24.9 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete basement or over crawl
Walls	Concrete, R-19
Ceiling	Flat roof, R-30
Windows	Single or double pane in aluminum frame
Sq. ft. windows	Single pane - 370 sq.ft. Double pane - 744 sq.ft.

BLDG. SYSTEMS

Heating	Hydronic system with heat pumps and electric boiler
Air conditioning	Hydronic system with heat pumps
Hot water	120 gallon electric
Refrigeration	Small load
Interior lights	14,364 w fluorescent 12,120 w incandescent - 1.61 w/sq.ft.
Exterior lights	120 w fluorescent 600 w incandescent 3700 w HPS
Equipment I	Battery chargers
Equipment II	Kitchen and office equipment

OFP401 is one of the newest buildings in the ELCAP sample. The 16,372 sq.ft. facility was built in 1984 after some community dissent concerning its location in the area. Because of this, particular attention was paid to building profile and placement on the property. The low, formerly swampy area is located between an area of single family homes and a main street primarily occupied by apartment and office buildings. Across the wide, divided street is a community college.

This is one 24 hour business where the fewer the customers the better, a local police precinct station. It is as far removed from "Barney Miller's" precinct in decor as it is in geography. The low modern concrete building has a 1,117 sq.ft. lobby with floor to ceiling windows. The single pane, blue-green glass has wide polished aluminum mullions. The double set of glass doors form an air-lock entry. An iridescent glass sculpture fills the back wall except for the open reception window and the locked doors leading to the rest of the station. The grey carpet and comfortable chairs help give the feeling of a light, airy office reception room, but one is aware of the camera monitors in the lobby and the police officer at the desk. Clerestory windows above the glass sculpture and the 350 sq.ft. of east-facing windows provide daylighting to the sculpture and the lobby. 4,200w of incandescent spotlights focused on the glass art work can also be turned on for even more light.

From the front the building gives the appearance of being one story with a small "police business only" parking lot for the public. But it drops off at the back exposing the two level structure. The basement is 2,887 sq.ft. of space under the north side of the building. The large parking lot for police vehicles and employee cars is located behind the builidng. Two gasoline pumps are at the south side of the parking lot.

When you leave the lobby you are in the working area of the precinct. A hall leads to a central room where computers and a typewriter are available to the officers. Around this core are interview rooms, commander's office and other offices, roll call room, library, recreation lounge and kitchen.

The north side of the building has the locker and exercise rooms, the intake and holding rooms. At the back is the unconditioned sally port where patrol cars can come in with their prisoners to take them out of the car and into the building.

In the basement are storage rooms and the long narrow shooting range.

Some advanced technology was applied in the construction of the building, but in other areas less than optimum construction for efficient operation were used.

The building met the Energy Code for a commercial building when built, an average of at least R-4 for walls and windows, but has the large expanse of single pane windows (R-1) concentrated in two places, the lounge and the lobby.

The above grade walls are concrete with six inch batt insulation, R-19. Below grade concrete walls have two and a half inches of insulation, R-7. Window openings on the south side have had the lower part filled with insulated panels with two inches of foam, R-8. This creates the appearance of long narrow windows high on the wall. The holding cells have an extra six to twelve inches of concrete instead of dry wall on their interior walls.

The main roof system has R-30 styrofoam insulation above the metal deck. There is a three foot airspace and then the acoustical tile, dropped ceiling. The sloped roof of the clerestories has R-8 rigid insulation. The floors are concrete basement or concrete over an unvented crawl space.

There is more variety in window types than is usually seen in commercial buildings. 264 square feet double pane clerestory windows fact north, south and west, providing daylighting to the center spaces in the building. The 375 sq.ft. of west facing windows in the lounge are tempered, single pane, blue-green glass with silver varitran 2-720 coating. 330 sq.ft. of south and east windows are double pane blue-green glass. The lobby area has 320 sq.ft. of east facing, single pane blue-green glass. 20 sq.ft. of north windows are double pane. All frames are aluminum.

HVAC system is state-of-the-art for the time it was constructed. The fourteen heat pumps utilize a central hydronic system. An electric boiler heats the water when more heat is needed. A cooling tower disipates the excess heat when the heat pumps are in the cooling mode. It is possible to cool one area, putting the heat into the hydronic system which is used to warm a colder area of the building.

The system does have timing controls, but the building is utilized twenty-four hours a day so the timing controls are not being used at this time. If the building is converted to some other use in the future the controls could be of great value.

The interior lighting load is primarily 40w or 34w fluorescent ceiling lights. Incandescent lights are used for decorative lighting in the lobby and in the commander's office, shooting range and locker rooms. All of the individual interior lights are manually controlled.

The exterior lighting, which is controlled by a timer, is High Pressure Sodium for the parking lots and the gas pumps. Incandescent lights are used at the entrances.

Data:

With only the month of March 1987 the data are limited. The last week of the month has a different pattern of consumption than the rest of the month. Mixed HVAC, ventilation and heating all increase, graph #2. Outdoor temperature changes would not explain the changes in consumption. Similar days do not show this pattern. On further investigation it was determined that the station master, who is very conscientious was not on vacation, there was not an increase in population or in activity. But, the interior walls were painted about that time. As this information is more than a year old it is difficult to get exact dates.

Interior lights show some variation from day to day, graph #2. Community meetings are sometimes held in the building in rooms not normally lighted. Also the bank of lights for the glass sculpture are manually controlled and may or may not be turned on.

The hourly schedule, #3 is unlike most other commercial buildings, using less energy during the day than at night when it must be heated this time of year. Also the winter bills are 20 to 40 percent higher than summer bills indicating more need for heat than a daytime only operation.

Auditor's Observations and Recommendations:

1. The operation and maintenance of this building is the most important factor in its energy use. The Station Master is responsible for the daily operations, such as: changing regular light bulbs, turning off lights and being aware of when DAS (Department of Administrative Services), who takes care of the major maintenance of the building, needs to be called.

Since this is a 24 hour operation HVAC controls need to be set at optimum levels for comfort and efficiency for each area and set for times of occupancy for each area. Lighting controls for those lights that can be turned off during the day would be appropriate. The next person in charge might not be as faithful about turning them off as the present Station Master.

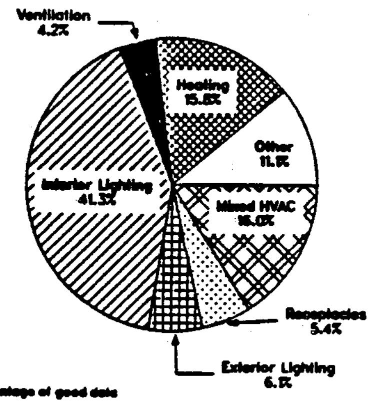
2. The lounge area is used twenty-four hours a day and argon filled, double pane, tinted, low E glass would be a great improvement. Replacing the windows would be very expensive. It would have been better to have installed them at time of construction. The incremental cost would have been reasonable. The tint in the east and west windows and the film on the west windows do decrease the solar gains.

3. The incandescent lights in the lobby and other areas could be changed to fluorescent. This would provide a savings on lighting and air conditioning, with some increase of heating load on the coldest days. Since heat pumps furnish most of the heat this increase in heating load is much more efficient than the heat from the lighting.

4. Heat recovery from the exhaust system or water heater heat pump could preheat the water for the large electric water heater.

SITE 548 3/ 1/87 to 3/31/87

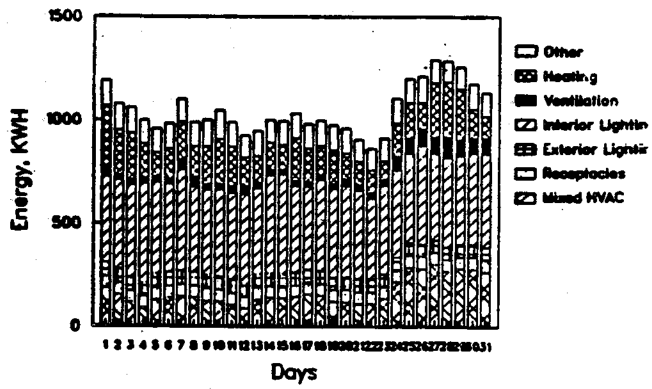
Share of Total Electricity Consumption 32,582 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

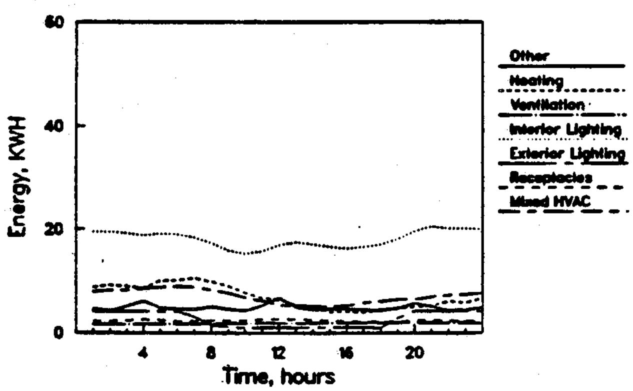
SITE 548 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



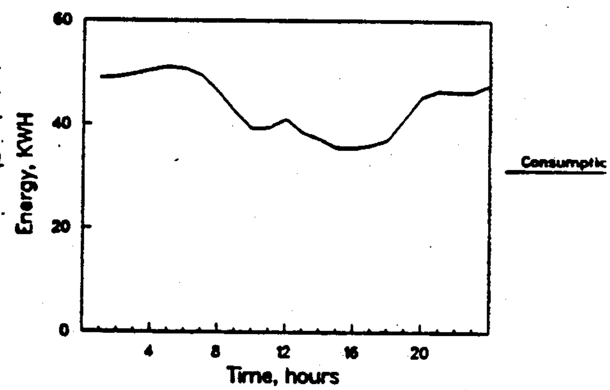
SITE 548 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



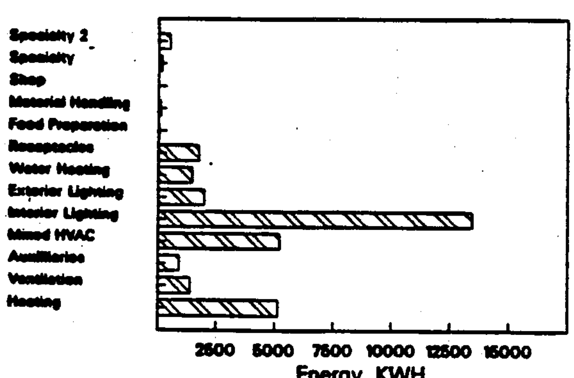
SITE 548 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 548 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID OFP 402 | Year Built 1983

Primary Use Office/shop | Square Feet 9440

Hours per week 45

Yearly Consumption - Electrical - SCL Billing

1985 - 135,360 - 13.6 kwhs/sq.ft.
1986 - 129,120 - 12.9 kwhs/sq.ft.
1987 - 121,921 - 12.9 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade/below grade
Walls	Concrete with R-4.3 or metal with R-19
Ceiling	Built up roof, R-15.4 insulation; 2 ft. air space, acoustic tile
Windows	Clear double pane in metal frame
Sq. ft. windows	428

BLDG. SYSTEMS

Heating	Air to air heat pumps with electric resistance backup
Air conditioning	Air to air heat pumps
Hot water	50 gallon electric
Refrigeration	Small
Interior lights	22,774 w fluorescent 520 w incandescent - 2.8 w/sq.ft. 3,200 w HID
Exterior lights	80 w fluorescent 12,185 w HID
Equipment I	Shop equipment
Equipment II	Office equipment

OFP402 was built in 1983 for the Washington Department of Transportation's highway signals and lights service. The 9940 sq. ft. building is built into the side of a slight slope, almost under the freeway. Many of the outside storage yard lights are mounted on the underside of the freeway. Inside there are 3040 sq. ft. on the first floor and 6900 sq. ft. on the second floor.

The main entrance in on the lower level. There is not a reception area but the people in the open office, just inside the doors fill the receptionist duties. The manager's office is off to the right, to the left is a hallway; then a small lunch room, stairs to the upper level, rest rooms, utility rooms and finally a door to the 975 sq. ft. storage garage which is 19 ft. to the ceiling.

Upstairs are more offices, the electronics shop and electrical shop, file storage and a 2129 sq. ft. storage area. This floor is at ground level at the back of the building.

All floors are concrete, below grade or on grade. Outside walls are 8-inch concrete with R-4.3 rigid insulation in the storage area and shop areas. The exterior walls on the first and second floor office areas are metal panel with R-19 batt insulation.

All walls are finished on the interior with gypsum wall board. Windows are double pane, clear glass in metal frames, 346 sq. ft. facing west and 82 sq. ft. east. there are seven doors totalling 147 sq.ft. and three metal roll-up overhead doors totalling 436 sq.ft.

The built up roof has R-15.4 rigid insulation, a two-foot air space and a suspended acoustic tile ceiling.

In spite of being so close to the freeway, it is quiet inside the building. The massive 8-inch concrete wall, the slope into which the building was built, the insulation, the few windows on the noisy side and double panes of all the windows help mitigate the noise.

In back and along side the building is a fenced storage yard for large freeway sign structures, light poles and other assorted highway equipment. This yard and the fuel pumps are lit by high pressure sodium and mercury vapor lights on poles around the area. The soffits of the building have high pressure sodium lights. Exterior lighting totals 13,105 watts, controlled by photocell to come on at dusk and a time clock to stay on until about 10 p.m. The timer also controls the few, which stay on all night for security.

Interior lighting is mostly four-foot 2 tube, fluorescent, recessed ceiling fixtures. In the offices there are two switches, one turns on one-fourth of the lights, the other turns on the other three-fourths. In the electronics and the electrical shop one switch turns on one tube in each fixture and the other switch turns on the other tube in each fixture. These features are not used. Usually all the lights are turned on. Incandescent lights are used in the restrooms and in the exit signs. Most task lighting is fluorescent.

HVAC system has six air to air heat pumps with electric resistance auxillary heat, intake and exhaust fans. Each serves a separate area so it is possible to control temperatures in each area. The second floor receiving area at the back corner of the large storage area, and far from the other conditioned areas, has electric resistance heat.

Some areas such as the large storage garage are not conditioned to the same levels as are the office areas. This zone control system was disrupted by an open "balcony" from the second floor to the 19 ft. high storage garage. The thermostat controlling the heat pump for some offices was placed on the wall next to the opening. When the storage area was cool, it turned on the heat in the offices, making them unbearable. When the storage area was hot, it turned on the cooling mode, freezing the office workers. This problem has now been solved. In January 1987 the opening was walled off, separating the climate of the storage area from the thermostat for the office.

Data:

The end use data for March 1987 shows a building with only small variations in daily consumption, graph #2. There are some differences on the weekends as people do occasionally work those days.

This building demonstrates how difficult it is to relate heating or mixed HVAC with heat pumps to outdoor temperature changes in mild weather when the building has insulation and is used only during the day. The outdoor temperature changes were small during this particular month. The average high was 55°F, the average low, 43°F.

In the winter months when resistance heat must be used the total consumption makes a dramatic leap. 16,560 kwhs for one cold winter month in 1985 compared to 13,680 kwhs for the same time period in 1987, which was more moderate, (from SCL billing information). A 3D graph would be dramatic showing the time of day and the day this occured.

The hourly profile, graph #3, shows typical operation for this type of building. There is some activity around 5 a.m. to 6 a.m., then a large increase in HVAC and heat just before the majority of employees arrive at 7:30 a.m. The interior lights and some other equipment turn on as the regular work day starts. All of these uses drop at the end of the day. The specialty equipment in the electrical shops and the receptacles remains on all the time with only small fluctuations.

Auditor's Observations and Recommendations:

1. Consistent, conscientious regulation of the controls for the building's HVAC and lighting systems offer the best "no cost" opportunity for electrical savings in the building. Some of the lighting controls are not being utilized now but could be used to turn down light levels when they are not needed.

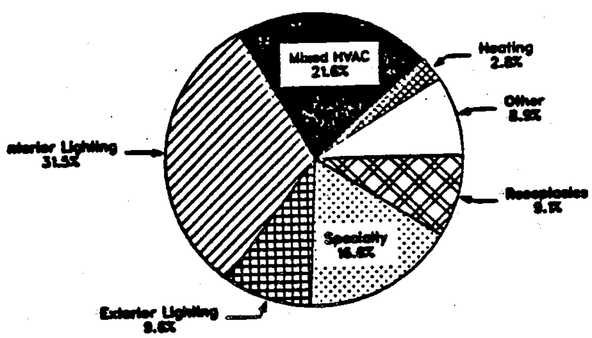
2. Other equipment, which is left on 24 hours could be turned off when not in use.

3. A small amount of savings at very low cost could be achieved by changing the few incandescent lights to fluorescent.

4. Occupancy sensors for the lights in little used rooms would assure the lights were turned off when no one was in the kitchen, restroom, file room, etc., but these lights do add heat to the building in winter. The savings would be in the summer, when the building is being cooled.

SITE 298 3/ 1/87 to 3/31/87

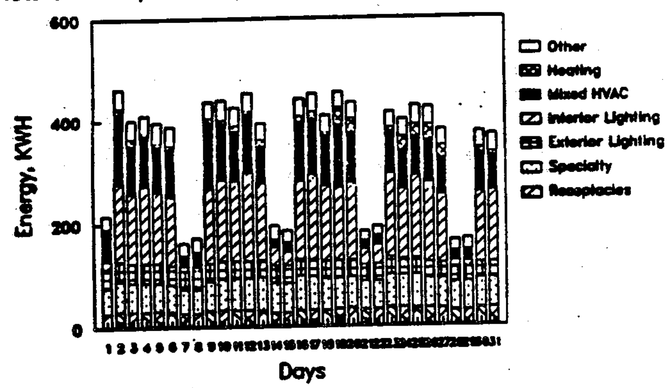
Share of Total Electricity Consumption 10,826 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

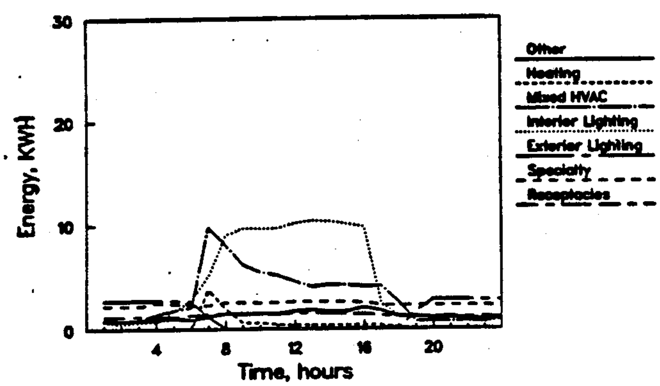
SITE 298 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



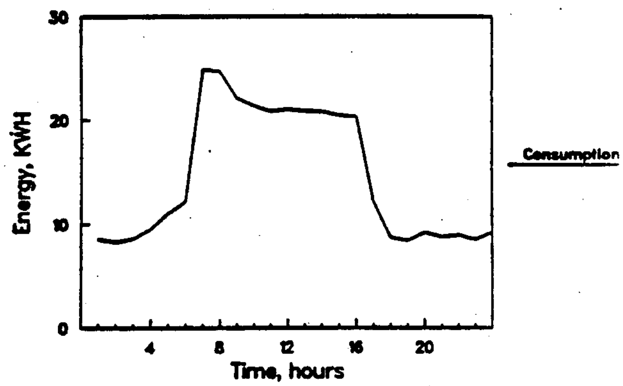
SITE 298 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



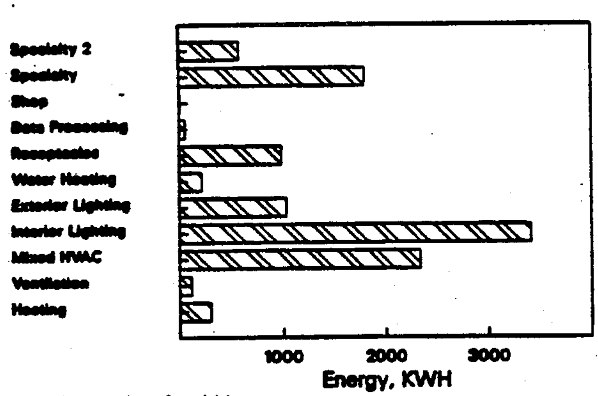
SITE 298 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 298 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID OTH001 | Year Built 1910

Primary Use Costume rental | Square Feet 2,112

Hours per week 40

Yearly Consumption - Electrical - SCL Billing

1985 - 8866 kwhs - 4.2 kwhs/sq.ft./yr.
1986 - 7995 kwhs - 3.8 kwhs/sq.ft./yr.
1987 - 7106 kwhs - 3.4 kwhs/sq.ft./yr.

Available End Use Data

June - December 1986

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade - residential area Uninsulated over crawl - shop area
Walls	Wood frame, R-11 insulation - residential area. Wood siding + plywood or corrugated fiberglass - shop area.
Ceiling	Over residential - R-23 Over shop - flat roof, no insulation
Windows	Single pane in aluminum frames
Sq. ft. windows	219

BLDG. SYSTEMS

Heating	Gas furnaces & electric resistance baseboards
Air conditioning	--
Hot water	30 gallon gas
Refrigeration	Residential size
Interior lights	2280w incandescent > 1.6w/sq.ft. 1000w fluorescent >
Exterior lights	75w incandescent
Equipment I	Sewing machine
Equipment II	Washer-dryer

The OTH Classification is for "Other," meaning it does not neatly fit into one of the common classifications. This is certainly true of OTH 001, one of the smaller, but more interesting sites in the ELCAP sample, a costume rental shop.

The shop is housed in what was a small neighborhood grocery store- residence, built about 1910. It is in a neighborhood of modest, single family homes. It was originally a one-story frame structure over a crawl space. A second story over the back or residential portion was added some years ago.

The "store" houses the display and main storage area. The next section, the "back room," is a large, sunny household kitchen-work room combination with a 9 x 4 ft. window facing east. Underneath these areas is a gravity-fed gas furnace in the uninsulated crawl space. A 4 x 4 open grate in the floor lets the heat rise to heat these sections. An electric baseboard heater supplements the heat in the display area. A living room and bathroom complete the first floor. The second story has two rooms which are heated by a small gas furnace with a blower and with ducts to each room. A small bathroom has an electric wall heater.

The front "store" area originally had large display windows on three sides. These have been replaced by single plywood panels on two sides and a corrugated fiberglass section on one side. There is no insulation in these walls. The walls in the other zones of the building have 3.5 inches of batt insulation. The ceiling of the "store" section has a flat roof deck with no cavity and no insulation. The other zones have attic above the ceilings and have seven inches of batt insulation.

Lighting, both interior and exterior, is a minimal load. At times, the washer, dryer, iron and sewing machine are heavily used due to the nature of the business.

The domestic hot water heater and the kitchen stove are gas which complicates sorting out heat load vs. other uses. Only one gas furnace has an electric fan. It is monitored in the general use load.

Since 1967 the operation has been run by one woman, who lives in the back residential section, and an assistant. It is a seasonal business. Halloween is the busiest time of the year with up to 20 customers at a time in the shop. At Easter time the owner had a large rack of bunny suits of all sizes and colors in the front area and was working on them for the Easter season. The hundreds of other costumes were neatly hung on racks or stored in bins in the main sales/display area.

Data:

We have seven months of data, June - December 1986. The monitored loads are not discreet. The only loads not mixed are the electric clothes dryer and one of the two electric heaters.

However, we can see how total load increases from 224 kwhs for June 1986 to 1121 kwhs for December 1986, graph #1. The principal electric heat is separated from the rest of the load and shows a steady increase in response to outdoor temperature.

October also reflects increased activity in other uses as Halloween approaches, graph #2 for October. In November sanitation and general uses increase as costumes are cleaned after being returned, graph #2 for November. In general there is a higher level of activity in December than in June.

Because this site is esentially a house, with the front section used as a shop, the hourly profiles, graph #3, look more like household profiles with someone at home during the day than business only sites.

Auditor's Observations and Recommendations:

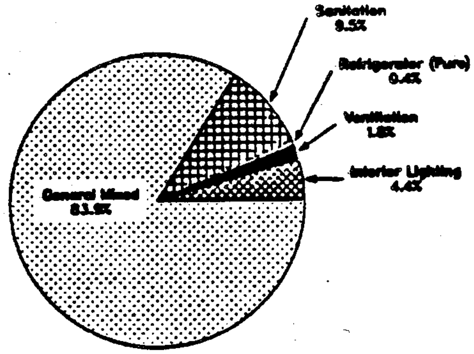
The residential area of the building has R-19 insulation in ceilings and R-11 in walls.

1. Single pane windows could be changed to double pane.

2. The front, or store area, has a very high total UA. It is an old structure, difficult to improve. The flat roof would be very expensive to insulate. The wall areas used to be large windows. The plywood and fiberglass panels which replace them have no cavity which could be filled with insulation. The floor is not insulated. Total restructuring to make this portion energy efficient would not be feasible for this small business. A simple strategy would be to close off the business area at the end of the business day and on slow days. The electric heat in this front area should be turned off except during the coldest business days.

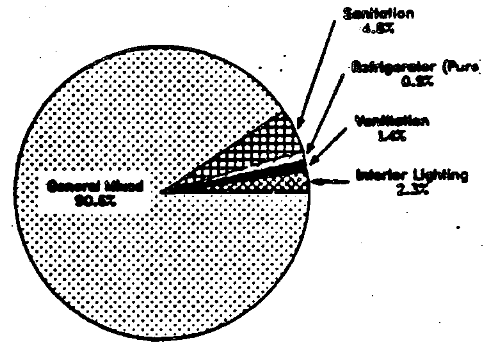
SITE 722 7/ 1/86 to 7/31/86

Share of Total Electricity Consumption 253 KWH
by End-Use *



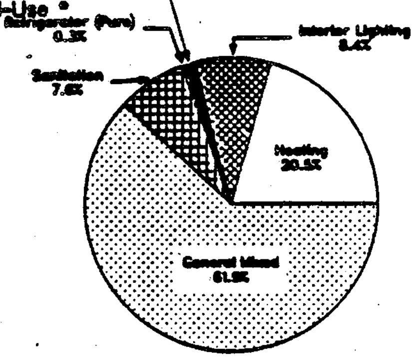
SITE 722 8/ 1/86 to 8/31/86

Share of Total Electricity Consumption 246 KWH
by End-Use *



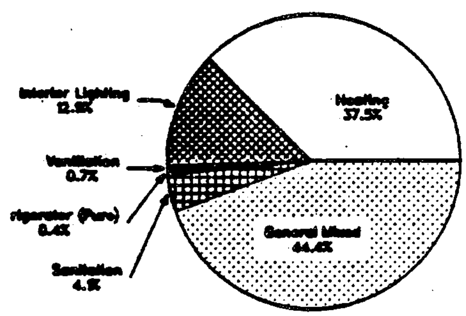
SITE 722 9/ 1/86 to 9/30/86

Share of Total Electricity Consumption 325 KWH
by End-Use *



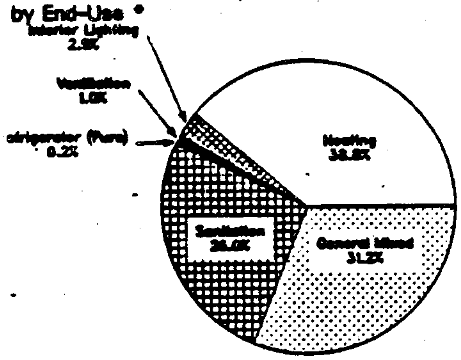
SITE 722 10/ 1/86 to 10/31/86

Share of Total Electricity Consumption 713 KWH
by End-Use *



SITE 722 11/ 1/86 to 11/30/86

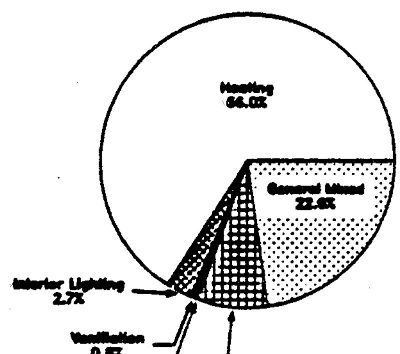
Share of Total Electricity Consumption 950 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 722 12/ 1/86 to 12/31/86

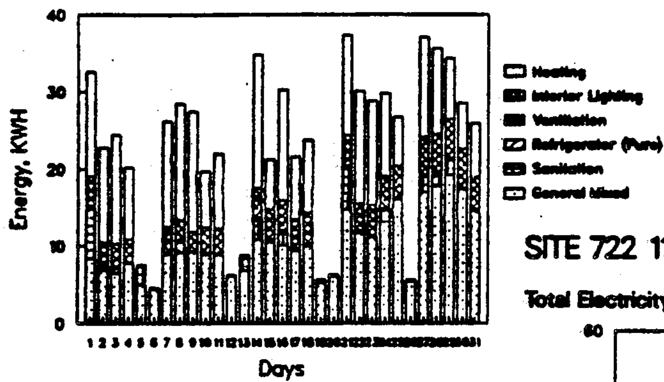
Share of Total Electricity Consumption 1,121 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 722 10/ 1/86 to 10/31/86

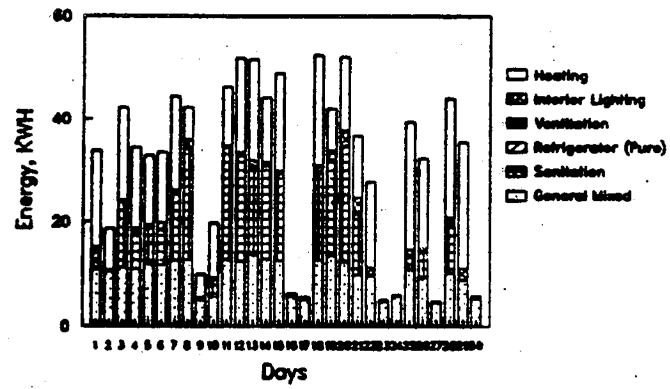
Total Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

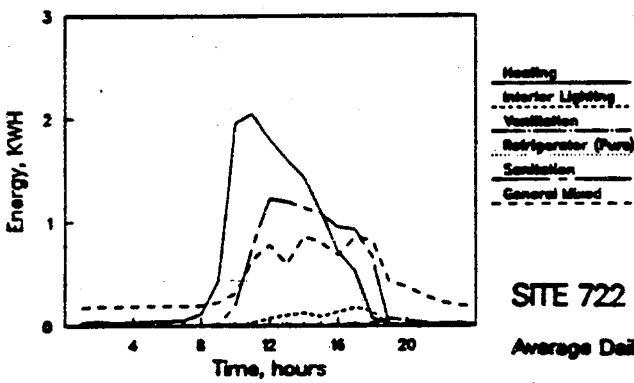
SITE 722 11/ 1/86 to 11/30/86

Total Electricity Consumption by End-Use *



SITE 722 11/ 1/86 to 11/30/86

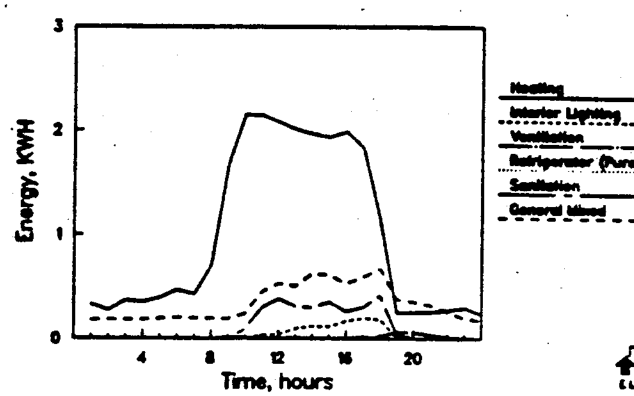
Average Daily Electricity End-Use Profile



Sample size = 1

SITE 722 12/ 1/86 to 12/31/86

Average Daily Electricity End-Use Profile



ELCAP

Bldg. ID OTH002

Year Built 1962

Primary Use Service Station

Square Feet 1434

Hours per week 55

Yearly Consumption - Electrical

1985 17,933 - 12.5 kwh/sq.ft.
1986 17,947 - 12.5 kwh/sq.ft.
1987 15,995 - 11.2 kwh/sq.ft.

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Single sheet metal
Ceiling	Sheet metal with built up roof
Windows	Single pane in metal frame
Sq. ft. windows	517

BLDG. SYSTEMS

Heating	Forced air gas
Air conditioning	None
Hot water	Electric
Refrigeration	--
Interior lights	2296w fluorescent - 1.6 w/sq.ft.
Exterior lights	700w mercury vapor 5600w fluorescent
Equipment I	Gas pumps
Equipment II	Battery charger

OTH002 has had a startling appearance change since the original audit, but there have been no changes in ownership/management or in equipment. The service station is now independent of any large oil company. To declare his independence the long time owner has chosen purple and gold, the local university's colors, for the entire building, the canopy over the gas pumps and anything else that could be painted. There is no other station like it.

This neighborhood fixture is located in a residential area on a busy through street and depends on loyal local patrons. The owner limits his hours and, unlike most other service stations, is open only from 6 a.m. to 5 p.m., five days a week. He is closed Saturdays, Sundays and holidays.

The 1,434 square foot building was constructed in 1962. There is a 146 square foot office at the southeast corner and 111 square feet of restrooms at the back corner. The remainder is service garage and storage. The walls are single sheet steel panels and in the office and rest rooms, double sheet steel panels with a two inch air space. Windows are single pane in metal frames. The ceiling is sheet steel with two inch air space, 3/4 inch plywood and a built up roof. The floor is concrete slab on grade.

Heat is supplied by a forced air gas furnace. The whole building was considered a single zone when the survey was done. Interior lights are four and eight foot fluorescent tubes which total 2,296 watts. Exterior lights are a 700 watt mercury vapor light and 5,600 watts of fluorescent tubes. The owner is very concientious about turning off things, including the electric hot water heater, when he goes home for lunch or for the evening.

<u>Observations</u>

1. The potential for electric savings in this building is small. The building is not insulated, but it is gas heated. It is operated only 55 hours a week during day time hours.

2. The greatest opportunity for electric savings would be to change the exterior lights. The mercury vapor lamp and most of the fluorescent tubes could be changed to high pressure sodium.

3. When the hot water tank needs to be replaced a small, efficient, six gallon tank or an instantaneous water heater would allow the owner to leave it on and would save some energy rather than heating a cold 40 gallon tank every day.

Bldg. ID OTH003 Year Built 1940

Primary Use Laundry - Dry Cleaner Square Feet 2,468

Hours per week 105

Yearly Consumption - Electrical - SCL Billing | Available End Use Data

1985	58,857	23.8 kwhs per sq. ft.	NONE
1986	60,251	24.4 kwhs per sq. ft.	
1987	59,802	24.2 kwhs per sq. ft.	

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete, concrete block, metal, wood without insulation, wood with R11 insulation, below grade concrete.
Ceiling	Flat, wood deck, built up roof
Windows	Single pane wood or metal frame
Sq. ft. windows	369 sq. ft.

BLDG. SYSTEMS

Heating	Gas heaters, electric baseboards
Air conditioning	Small room air conditioner
Hot water	Gas fired boiler
Refrigeration	--
Interior lights	3456 w fluorescent 425 w incandescent - 1.58 w/sq. ft.
Exterior lights	--
Equipment I	Washing machines
Equipment II	Gas dryers

OTH003 is a building of indeterminate age, which appears to have started out as a gas station sometime in the 1920's or 1930's. There have been many modifications and additions to the building. It has been occupied by the current tenant, a laundromat - dry cleaner since 1964.

The building is located on the corner, facing south to a busy street. There is a very small concrete parking area. Like the 2,468 sq.ft. building the parking is a very cramped space. The north side of the storage area of the building is built into the hill. There is very little space behind the rest of the building.

There are six wall types, concrete, concrete block, metal, wood with insulation and wood without insulation, and below grade concrete. About half the walls are insulated. The ceiling is hot tar built up roof on wood deck. The floor is concrete slab on grade and below grade. The 369 sq.ft. of windows are single pane in wood or metal frames, of which 277 sq.ft. face south.

Interior lighting is provided by 8 ft. fluorescent ceiling tubes. Exterior lighting has only a revolving neon sign on top of the building. It is so close to the sidewalk that the street lighting provides lighting to the small parking area.

Heat is provided by two gas heaters. In the dry cleaning area there is a 1,500w electric baseboard heater and a small wall air conditioner. Because of the heat generated by all the equipment there is a recirculation fan and the actual heating equipment is not needed very often.

The equipment in the building includes 30 washers, 18 gas dryers, two dry cleaning machines, a gas water boiler, air compressor, change, soap and coke machines.

The small 375 sq.ft. dry cleaner area at east end of the building is open from 8 am to 6 pm, Monday through Thursday. The larger laundromat area is open 8 am to 11 pm everyday including holidays.

OBSERVATIONS

The data logger was removed from the building the end of 1987, and the building is no longer in the ELCAP sample. While it may be typical of a few small commercial buildings it is difficult to sort out loads and even the thermal value of the various building components. It's days are probably numbered and we can expect to see a new more efficient building on the site before long.

Bldg. ID OTH103 | Year Built 1948

Primary Use Church - Day Care | Square Feet 7,992

Hours per week Day Care - 58 hours, Church - 6 hours

Yearly Consumption - Electrical - SCL Billing

Available End Use Data

NONE

	Church		Day Care		
1985	16,680 kwh	+	48,240 kwh	=	64,920 kwh = 8.1 kwh/sq.ft.
1986	13,200 kwh	+	48,680 kwh	=	61,880 kwh = 7.7 kwh/sq.ft.
1987	11,120 kwh	+	42,800 kwh	=	53,920 kwh = 6.7 kwh/sq.ft.

BLDG. CHARACTERISTICS

Floor	Concrete basement/concrete slab on grade.
Walls	Lower walls - concrete, upper walls - wood frame & wood siding. Addition - wood siding with R11
Ceiling	Church - wood deck, shingles Addition - built up flat roof R4 insulation
Windows	Church - single pane, wood frame. Remainder - single pane, metal frame.
Sq. ft. Windows	639 sq.ft.

BLDG. SYSTEMS

Heating	Church - forced air oil furnace Remainder - electric resistance baseboards.
Air conditioning	--
Hot water	30 gallon electric
Refrigeration	--
Interior lights (approx.)	4720 w fluorescent 6935 w incandescent - 1.45 w/sq.ft.
Exterior lights	300 incandescent
Equipment I	--
Equipment II	--

OTH103 built in 1948 is a small, New England style, brick church set on a grassy knoll in a residential neighborhood. From the street side it looks very quiet and peaceful. As you go around to the side yard - parking lot you see a very different aspect. A two story addition has been built along side the sanctuary creating a school with a daylight basement connected to the basement of the sanctuary and a flat roofed second floor which contain classrooms. During the week this part of the building houses a very active day care center. There is a playground at the back of the building and the large fenced parking lot is also used as a play area. A small frame building at one corner is not included in the survey.

The entrance to the day care is at the back of the building. As you go in it is very quiet as most of the class room doors are closed, separating small groups of different age children. However, when it is time to go out to play the hallway comes alive. The nicely finish classrooms are carpeted, some have built in carpeted elevations which provide seating for the children. Indoor activity equipment and the usual preschool pictures give the rooms a cheerful look even though the rooms under the sanctuary are in a basement. The large 5x6 windows in window walls provide lot of daylight to supplement the fluorescent ceiling fixtures.

The building has concrete lower walls and floor, the walls of the sanctuary are brick, gables are wood siding with gypsum wall board interior. The walls of the upper part of addition which was built out from the basement, are wood siding with R11 insulation, finished with gypsum wall board inside.

The church roof is 4 inch wood deck with composition shingles. The flat built up roof on the addition has 1-inch rigid insulation and 3-inch wood deck. Windows in the church are single panes in wood frame and the windows in the basement and in the addition are single pane in metal frames. Sanctuary doors are solid core wood and others are wood with single pane windows.

The original heating system is a forced air oil furnace. The additional classrooms have individual electric resistance baseboard heater. The sanctuary and rest rooms have air exhaust fans. There is no air conditioning. Hot water is supplied by a 30 gallon electric tank.

OBSERVATIONS

The incandescent lights could be changed to more efficient fluorescent lights. The organization, Interfaith Coalition of Energy (ICE) publishes conservation materials just for churches. This type of information could be useful to the small church.

Bldg. ID OTH104	Year Built 1913
Primary Use Library	Square Feet 7595
Hours per week 40	

Yearly Consumption - Electrical	Available End Use Data
1985 28,200 = 3.71 kwhs/sq.ft.	NONE
1986 34,800 = 4.58 kwhs/sq.ft.	
1987 33,440 = 4.40 kwhs/sq.ft.	

BLDG. CHARACTERISITICS

Floor	Concrete basement/wood over crawl - no insulation.
Walls	Concrete & brick - no insulation.
Ceiling	Attic space, no insulation.
Windows	Single pane, some leaded glass in wood frames. (200 sq.ft double pane on stained glass)
Sq.ft. windows	1077 sq.ft.

BLDG. SYSTEMS

Heating	Gas, hot water boiler, forced air, over coils.
Air conditioning	None
Hot water	52 gallons electric
Refrigeration	--
Interior lights	480 w fluorescent 7835 w incandescent - 1.09 w/sq.ft.
Exterior lights	600 w incandescent, on time clock
Equipment I	Office equipment
Equipment II	--

OTH104 is a beautiful old Carnegie library, built in 1913 as part of the Seattle Public Library System. It is now on the register of Historical Buildings. The main entry with its solid oak reception desk is separated from the book stacks and the reading rooms by solid wood panels with leaded glass at the top section so the librarian can see all sections of the library. The ceiling in the main sections is fifteen feet high and in the back corners, over the office, rest rooms, storage and lunch room it is nine feet. The ten foot high, single pane, leaded glass windows at the sides, the six foot high leaded glass windows at the front and back and the four skylights over the back of the main room make the library bright during the day.

The above grade walls are concrete with brick facing, with no insulation, the below grade walls are concrete with no insulation. Walls in the heated parts of the building are concrete, finished with plaster. The basement under half of the building is concrete and contains a small auditorium, mechanical and storage rooms, and rest room. The other half is a crawl space with a dirt floor. The floor above is 3/4 inch planks covered by linoleum tiles. The sloped roof over the front section is slate tiles on 3/4 inch planks, attic space, then more of the 3/4 inch planks which are finished with plaster. The back section of the library has a flat, built up roof on 3/4 inch planks with a two foot air space, planks and finished with plaster. There is no insulation.

Lighting is provided by suspended incandescent fixtures, most with 120 or 300 watts. The only fluorescent lights are six 80 w fluorescent tubes in the office. Exterior lights are six pole lights with 100 w of incandescent bulbs in each. These are controlled by a time clock.

Heat is provided by a gas fired hot water boiler with circulating pumps and fan. There is also a ventilation supply system. Domestic hot water comes from a 52 gallon electric tank.

Over the last several years the Seattle Library has been refurbishing its older libraries and restoring them to their original grandeur as much as possible. The HVAC systems and thermal properties of the buildings are also being updated. This library is scheduled to be closed from October 1988 until about May 1989 for a complete overhaul of systems and of building components. The heating fuel will continue to be gas. Because it will be out of the sample for such a long time PNL plans to discontinue monitoring the site when it closes.

AUDITOR'S OBSERVATIONS

The complete remodel of the building offers a golden opportunity to increase the efficiency of the building. Insulation will be added to the attic and other roof spaces wherever possible. The underfloor over the crawl space is to be insulated.

However, lighting offers perhaps the greatest opportunity for electric savings. All lighting will be changed. The heating system will be completely changed to a forced air, gas furnace and more outside air for ventilation will be provided. (Because of the building's "Historical" status all changes must meet rigid preservation standards).

Bldg. ID RES001 | Year Built 1972

Primary Use Pizza Parlor | Square Feet 1,876

Hours per week 84

Yearly Consumption - Electrical - SCL Billing | Available End Use Data

1985	123,971 - 66.08 kwh/sq.ft.	NONE
1986	121,026 - 64.51 kwh/sq.ft.	
1987	112,806 - 60.13 kwh/sq.ft.	

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	25% uninsulated brick, 75% stud wall with R11 insulation
Ceiling	Attic with no insulation.
Windows	Single pane in wood frame.
Sq. ft. windows	177 sq. ft.

BLDG. SYSTEMS

Heating	Forced air gas furnace.
Air conditioning	Two direct expansion air conditioners.
Hot water	50 gallon gas water heater.
Refrigeration	Walk in cooler, upright freezer & cooler, pie case, salad table, pop dispenser, ice machine, beer cooler.
Interior lights	520w fluorescent 2675w incandescent - 1.70w/sq.ft. After change: 1120w fluorescent 600w incandescent - .65w/sq.ft.
Exterior lights	On Time Clock: 3040w incandescent (sign lights) 300w Halogen After change: 2000w incandescent 180w fluorescent
Equipment I	Dough mixer
Equipment II	Dough roller

RES001 was built in 1972, about the time fast food restaurants, and pizza parlors in particular, began to flood the market. The restaurant has held its own the past sixteen years with little variation in operation levels. A salad bar was added in 1984, about the same time as a 196 sq.ft. walk in refrigerator was added. By current standards the restaurant is small (1876 sq.ft.), but the space is utilized to the maximum, providing pizza to up to 200 people an hour.

The restaurant is open from 11 am to midnight Monday through Thursday. Friday and Saturday it is open until 1 am. On Sundays it is open from noon until midnight.

The decor is the same for this restaurant as it is for all their other restaurants. Once inside you would not know in what part of the country you were. The corporate office in Houston recently (1987) decreed that all the incandescent bulbs in the hanging lamps and in the track lights inside the restaurant and in the frosted globes in the exterior soffits be replaced with compact fluorescent bulbs. This reduced the incandescent lights from 2675w to 600w inside the restaurant and reduced the exterior lights by 1160 watts. This is not a tremendous number of kilowatt hours saved but it represents a 400% decrease in the installed capacity for these fixtures. When multiplied by the number of restaurants belonging to this chain, the number is significant.

Heat is supplied by a forced air, gas furnace, cooling by two direct expansion air conditioners, ventilation by two exhaust and two supply fans. The kitchen has the expected electrical equipment, dough mixer and roller, proofer, walk in refrigerator, beer cooler, freezer, food warmer, various coolers, ice maker, coffee maker, cash register, computer terminal, video games and juke box. The heat, pizza oven and hot water are fueled by gas. Therefore, these large energy loads will not be on our electric energy graphs.

Building construction is also typical for the time it was built. The floor is concrete, slab on grade. The decorative brick is solid brick wall. The rest of the walls have had R11 insulation added. The windows are clear single pane glass in wood frames. The ceiling is a ventilated attic with a metal roof. The walk-in refrigerator addition has R19 in the walls & ceiling.

OBSERVATIONS

The most obvious measure has already been taken; changing the lights from incandescent to fluorescent. The next measure would be insulation in the attic. The heat producing equipment - ovens - coolers, etc. make this a less important measure then in an office building, but still one that could save on cooling in the summer and heating in the winter. Other shell measures would not be recommended.

Bldg. ID RES 002 Year Built 1970

Primary Use Full Service Restaurant Square Feet 3,627

Hours per week 83

Yearly Consumption - Electrical - SCL Billing

1985 - 171,180 kwhs - 47.2 kwhs/sq.ft./yr.
1986 - 165,600 kwhs - 45.7 kwhs/sq.ft./yr.
1987 - 155,160 kwhs - 42.8 kwhs/sq.ft./yr.

Available End Use Data

May and June 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete, no insulation. Upstairs, R-11
Ceiling	Flat built up roof R-19 and attic R-19
Windows	Single pane in metal frame
Sq. ft. windows	503

BLDG. SYSTEMS

Heating	Electric resistance
Air conditioning	Direct expansion
Hot water	120 gallon electric
Refrigeration	> 9609w
Interior lights	Incandescent 3254w, fluorescent 451w > 1.0w sq.ft.
Exterior lights	Incandescent 1650w, mercury vapor 525w
Equipment I	All electric food prep.
Equipment II	-

RES 002 has been operated by the same tenant since 1970. Yet the sign on the roof is that of a previous tenant. Although by now a few letters are missing, the readerboard out front still features the "Jimmy Carter Breakfast" advertised during the late 70's. The well-worn establishment has a loyal local clientele from the surrounding business and residential areas. Breakfast, barbecue, liver and onions, and soul food are featured along with the usual sandwiches. Several hand printed signs admonish customers; "no cursing allowed," "no checks or $100 bills accepted," "no change without a purchase" and a warning of no management responsibility for lost or stolen articles from the coat rack by the door.

The restaurant is open from 7 a.m. to 7 p.m. six days a week and from 8 a.m. to 7 p.m. on Sundays. Until the fall of 1986 it was open until 8 p.m. but the restaurant chef/manager felt it was not safe for his daughter, who helps run the restaurant, to be there so late.

The two story building was built in 1960. According to the original survey there have been no modifications or additions. The 2,871 sq.ft. first floor has a large dining room to the left of the entrance, a small one to the right. The entrance and the cashier separate the two areas. Behind the cashier a hall leads to the rest rooms and the kitchen and storage which occupy about half the first floor.

The first floor walls are concrete masonry with no insulation. The floor is concrete slab on grade. Windows are single pane in aluminum frame. 192 sq. ft. face the south parking lot and 258 sq.ft. face the west parking lot. Only 53 sq. ft. face north. There is a glass store front, aluminum frame door on the west and one on the south. Two solid core wood doors on the east side are exits from the kitchen.

A stairway in the northeast corner of the storage area goes upstairs to a 756 sq.ft. office and storage area. From the outside the second story gives a barn-like appearance with its Dutch colonial roof coming down to meet the flat built-up roof of the rest of the building. The center of the barn has a 5' x 7' opening for the large kitchen exhaust vent. The 8' 10" walls and the aluminum sided ends of this section have R-11 insulation. The attic has R-19. The rest of the roof of the first floor, mainly over the dining areas, has R-19 insulation.

HVAC systems are a direct expansion air conditioner with electric resistance duct heaters, exhaust and intake fans, portable electric resistance heaters and a swamp cooler/supply/circulation fan. The base-board heaters in the rest rooms do not work.

The refrigeration load has a 8' x 9' walk-in freezer, an ice maker, another freezer, display cooler, milk and dairy coolers, ice cream freezer case and two more coolers, one not plugged in.

All cooking and food prep is electric. There is an oven, food warmers, toaster, coffee makers, four grills and a waffle iron, microwave, mixers, pop dispensers and other equipment. Water is heated by a 120 gal. electric heater.

Kitchen lights are primarily fluorescent tube, ceiling fixtures, many burned out, and some incandescent bulbs also burned out or missing. Lights in the dining room are incandescent bulbs of various sizes, again some are burned out. The incandescent bulbs for the stairs and in storage areas are working. The upstairs section has fluorescent tube ceiling fixtures. The tenant complains about employees leaving the upstairs lights on and says he is going to start charging one fellow.

The twenty-two exterior soffit lights have 75w incandescent bulbs, about half are burned out. The fluorescent signs and mercury vapor parking lights have controls but they are not working. Also many of the tubes in the signs are burned out. The tenant lets the lamps burn out until he feels he must change them for safety reasons. He then goes down to the store, buys a few new ones and replaces those where more light is needed. He does not relamp the entire restaurant.

The operation is barely profitable. The tenant was having trouble paying his high winter electric bills. An electrical service representative from SCL came out and explained peak charges. Since then peak charges have been decreased about 20 percent. The chef does not turn on everything first thing in the morning, waiting until the lights and cooking have warmed up the building. He is still confused about the HVAC system and service people who have been out have confused him more. He is a chef, not an engineer. He does turn down the heat and turn off the air conditioning and the lights when not needed.

Data:

The data for this building is for May and June 1987. At this time of the year, 40 percent of the electric consumption is "other," and it varies daily. The exterior lights and the water heater are included in this load which help account for its nighttime use, graph #2. 38 percent of the load is for food preparation--the largest, single use for this month in this all electric restaurant, graph #1.

There is no simple explanation for the lack of HVAC from the 16th to the 23rd, graph #2. A year later it is difficult for the owner to remember what may have been going on at that time. The 3D for May-June graph for HVAC also clearly shows this absence of HVAC. The 3D graphs can show which hour of which day an usual change takes place. The 3D graph for interior lighting shows a gradual decrease. But at any one time, no more than about 33 percent of the interior lights are on. Several are burned out or turned off. The decrease in exterior lights can also be seen. However, since they are manually controlled, they are on longer some days than others. The rise in use from about the 10th to the 20th of May could be due to replacement of burned out bulbs, or more likely, to more lights being left on all night, as the load drops again later in the month. One caution, the scale of kwh's is not the same on all graphs. A very small load on a small scale may look equal to a large load on a large scale.

Auditor's Observations:

Although the present occupant says there have been no changes in the building since it was built, it is highly unlikely that R-19 was put in the flat roof or R-11 in upstairs walls and R-19 in the attic in 1960. I would guess these were added before the present tenant began occupancy in 1970. The tenant's confusion about his HVAC system may be because at some time someone recommended a heat pump to replace the present system. He is not sure what he has.

The initial cost of conservation measures would be high and would probably not be done by the owner or the tenant without some help from a conservation program. The tenant cannot afford the initial expenditure and, since the owner does not pay the electric bill, sees no advantage to himself.

Recommendations

1. There is great potential for electrical savings in this building. The simple and inexpensive replacement of the incandescent bulbs with fluorescent PL tubes in the dining room and in the exterior soffits would require some initial investment. It would soon pay for itself in kwh's saved, in cost of changing bulbs and in safety, an important consideration in this neighborhood.

2. Repair of and use of time controls would provide some savings as the lights are not consistently controlled now.

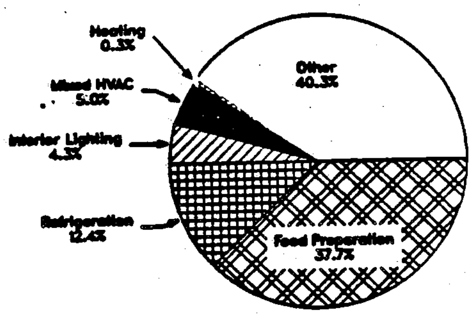
3. Window coverings or shades would help reduce the solar gains of the west and south windows. However, security is of great concern and the tenant may want to have as much exposure as possible to the outside.

4. A heat pump for HVAC and another for water heating would be good measures to install. Waste heat from the kitchen could be used for heating water and the cold air could be used to cool the restaurant in summer or discharged outdoors in the winter.

5. Operation and maintenance measures are not a priority of the tenant. If something breaks down it is not repaired or replaced unless it is absolutely necessary to the operation. Some instruction and help with O&M ideas, such as the suggestions by the electrical service rep, have been utilized by the tenant. Advice in this area could be very effective for the tenant.

SITE 564 5/ 1/87 to 5/31/87

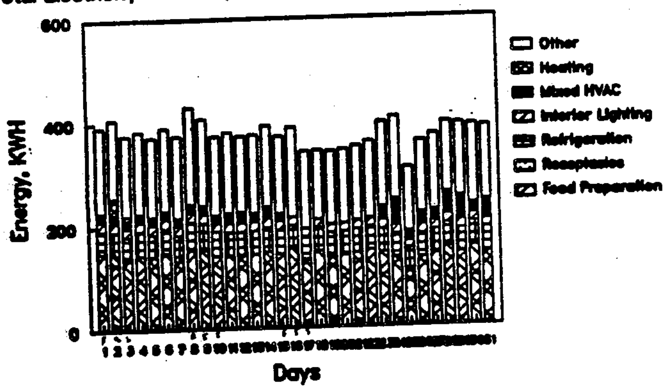
Share of Total Electricity Consumption 11,673 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

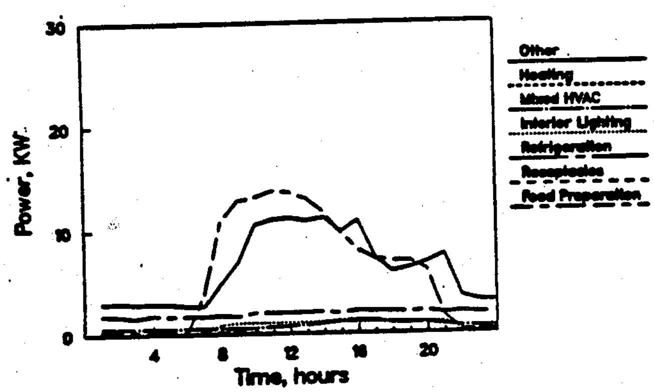
SITE 564 5/ 1/87 to 5/31/87

Total Electricity Consumption by End-Use *



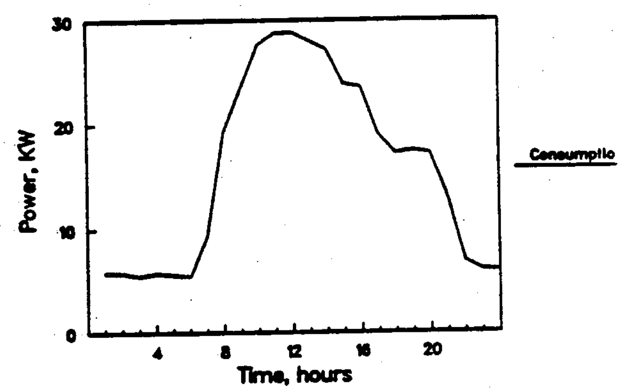
SITE 564 5/ 1/87 to 5/31/87

Average Daily Electricity End-Use Profile



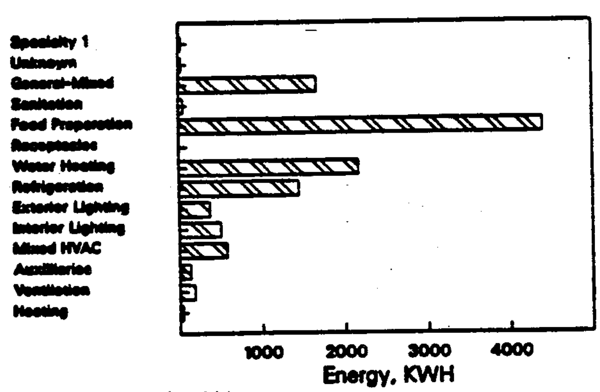
SITE 564 5/ 1/87 to 5/31/87

Average Daily Total Electricity Use



SITE 564 5/ 1/87 to 5/31/87

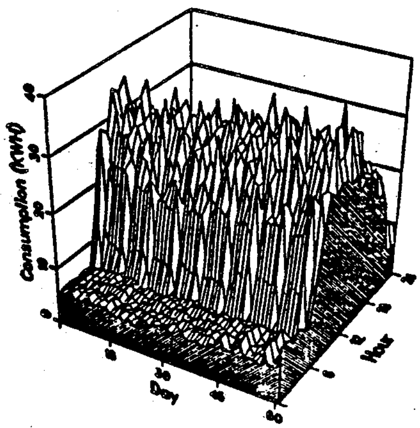
Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

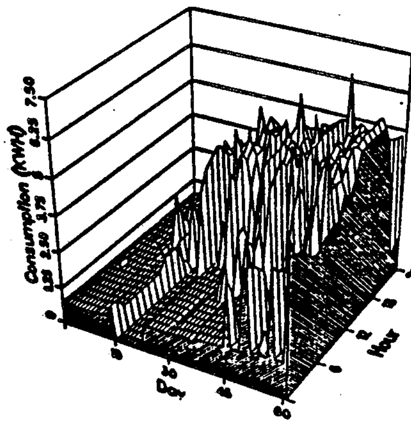
ELCAP

Site 564 June 1987



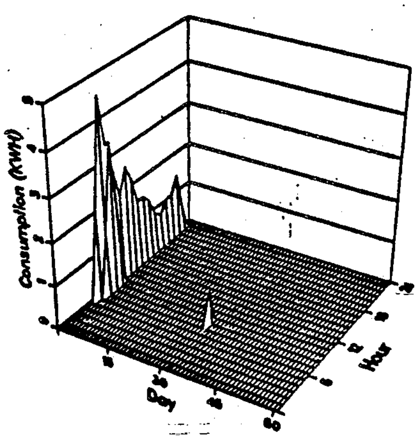
Building Total End-use
Restaurant Building

Site 564 June 1987



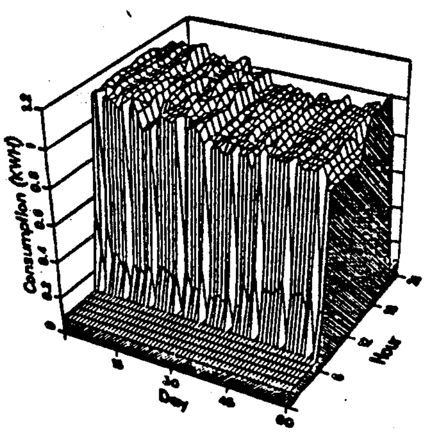
Mixed HVAC End-use
Restaurant Building

Site 564 June 1987



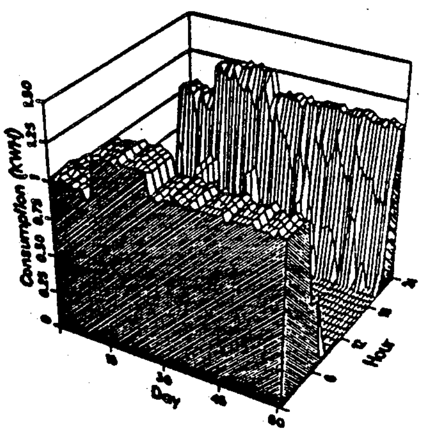
Heating End-use
Restaurant Building

Site 564 June 1987



Interior Lighting End-use
Restaurant Building

Site 564 June 1987



Exterior Lighting End-use
Restaurant Building

Bldg. ID RES005 Year Built 1960

Primary Use Fast food Square Feet 2,465

Hours per week 79

Yearly Consumption - Electrical - SCL Billing   Available End Use Data

1985	PUGET POWER	NONE
1986		
1987		

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Concrete, R2.6 insulation.
Ceiling	Flat roof, 2 foot air space, R20 insulation.
Windows	Single pane in metal frames.
Sq. ft. windows	219

BLDG. SYSTEMS

Heating	Forced air gas furnace, electric resistance unit heater.
Air conditioning	Direct expansion air conditioner, two evaporative coolers.
Hot water	50 gallon gas water heater and 50 gallon electric water heater.
Refrigeration	85 sq.ft. walk-in freezer, two upright freezers, ice machine, refrigerator and coolers.
Interior lights	2840w fluorescent 6560w incandescent - 3.8w/sq.ft.
Exterior lights	5370w incandescent 40w fluorescent neon signs
Equipment I	Food prep.
Equipment II	--

RES005 was built in 1960. It is obvious from the building changes in the architecture and decor that there have been several modifications of the building over the years. It now has the appearance of a new building and has kept up with the restaurant chain's attention to improve amenities to help maintain its share of the Mexican fast food market. The latest changes were made in April 1987. An ice cream display freezer with wells was installed in the front counter, two decorative neon signs were added to the above counter lights and a double pane, clear glass atrium with double door entries was added to the main dining room entrance on the north side.

The floor is concrete, slab on grade. The walls are concrete block with one inch, R2.6, insulation on the inside. Both inside and outside walls are finished with rough plaster to give the building a Mexican look. The ceiling has R20 above the ceiling tiles, a two foot air space and a flat built up roof. The main part of the restaurant is a 2,081 sq.ft. square shaped building with another 384 sq.ft. narrow section extending on the northwest corner to serve as the kitchen/service area for the drive-up window.

The windows in the dining room and drive-up are single pane, clear glass in metal frames, 159 sq.ft. on north side, 30 sq.ft. east and 30 sq.ft. west. Exit doors from the kitchen are insulated metal. Door from the drive-up section is wood and glass.

The main HVAC system is a direct expansion air conditioner for cooling and gas forced air furnace for heating. In addition the kitchen area has a 3000w electric unit heater and there are two evaporative coolers, one for the drive-up section and one for the other section. There are several heat exhaustion fans.

Refrigeration is a large electric load with an ice machine, two well type coolers, a regular refrigerator, two upright freezers and an 85 sq.ft. walk-in freezer. Cooking is done by two gas ranges, two gas fired deep fryers, an electric coffee maker, steam kettle, grill, microwave and several food warmers. Slicers, mixer, grater and pop dispensers contribute to the electric load for food preparation.

Hot water for the kitchen is supplied by a 50 gallon gas water heater and for the rest rooms by a 50 gallon electric water heater.

Interior lights in the kitchen are 2070w of incandescent, 2360 fluorescent. In the dining room there are 4050w incandescent plus some neon signs near the counter. The lights in rest rooms, office and break room are fluorescent and a couple of incandescent bulbs.

Exterior lights are 35-150w and two 60w incandescent bulbs, two HID in the drive-up and fluorescent tubes in the signs. Exterior lights are controlled by time clock to go on at dusk and off at 11 pm.

The restaurant is open 10:30 am Monday through Friday and 11 am Saturday, Sunday and holidays. It closes at 10 pm except on Sunday when it closes at 9 pm. It is located in a business district designed for driving, there is no foot traffic. There are usually about nine employees working at a time and an average of twelve or so customers in the restaurant. Lunch hour is the busiest time and can extend past 2 pm.

AUDITOR'S OBSERVATIONS

The first recommendations would be for lighting modifications. Both indoor and outdoor incandescent lights could be changed to fluorescent, saving about two-thirds of the electricity used by the present incandescents. This would be a simple and relatively inexpensive measure. The pay back would be short, especially since the business is paying Puget Power rates. This change would also decrease the demand on the air conditioning system in warm weather. The slight increase in demand on the gas heating system in cold weather would be less costly than the heat from the incandescent lights.

The atrium entry is attractive and provides an air lock entry, preventing an influx of unconditioned air. It also creates a more comfortable climate at the tables close to the door, they do not get a blast of unconditioned air every time the door is opened.

The hot water tank for the rest rooms could be replaced with an instantaneous one or a small six gallon tank as there is never a large, continuous demand for hot water in these areas.

When the present HVAC systems (age unknown) needs to be replaced, heat pumps with gas backup would be more efficient than the arrangement now being used.

The building has good ceiling insulation, probably added at one of the remodels. No additional shell measures would be recommended as this is a late, day time use building with high internal gains.

The chain's corporate office oversees the building, assuring some quality control over operation and maintenance. However, an inexperienced, constantly changing staff is responsible for day to day operations. The automated controls for exterior lights and for the HVAC systems help manage the systems without depending on the employees; important in this situation.

Bldg. ID RES 103	Year Built 1960
Primary Use Restaurant	Square Feet 3,393
Hours per week 97	

Yearly Consumption - Electrical - SCL Billing

1985 - 226,040 - 66.6 kwh/sq.ft.
1986 - 224,040 - 66.0 kwh/sq.ft.
1987 - 226,320 - 66.7 kwh/sq.ft.

Available End Use Data

March 1986 - July 1987

BLDG. CHARACTERISTICS

Floor	Wood over concrete basement - no insulation
Walls	Concrete with interior wallboard - no insulation
Ceiling	Built-up roof - dropped ceiling - no insulation
Windows	Single pane - wood, frame
Sq. ft. windows	278 sq. ft.

BLDG. SYSTEMS

Heating	Forced air gas
Air conditioning	Direct expansion air conditioner
Hot water	120 gal. electric
Refrigeration	> 8410w
Interior lights	______ w fluorescent 4555 w incandescent - 1.3 w/sq.ft.
Exterior lights	1500 w fluorescent 1068 w incandescent 360 w HPS
Equipment I	Food preparation
Equipment II	Dishwasher

Building RES 103 is a 140-seat neighborhood restaurant specializing in breakfast service from 6 a.m. seven days a week. The independent owner has operated the restaurant since 1972. It is located along one of the infamous, low rise, high traffic, business strips of the city. A medical building is against the south wall, an asphalt parking lot on the north side of the building. A driveway runs behind. The front, facing east, is directly on the sidewalk.

Week day customers in the morning and afternoons are local business people, trade people who pass that way in the course of their day. In the evenings and on weekdays most of the customers are residents of the adjacent neighborhood. Weekends are the busiest times, attracting large numbers of customers from a wide geographic area for breakfast/brunch. For a time about two years ago the restaurant closed at 4 p.m. This experiment did not last long and the 8 p.m. closing was resumed.

The 3,393 sq. ft. restaurant constructed in 1960 is a square concrete building over a basement. Interior walls are furred out and covered with wall board. There is no insulation. It has a flat built up roof on plywood deck, air space and wall board in food preparation area. The remainder has another air space and an acoustical tile ceiling. There is no insulation. Height from floor to roof is 16 feet. The single-glazed windows are across the east side and along the entry hallway on the north. The front door is a single glazed glass door in aluminum frame. The back door is wood.

Operator controlled lighting outside consists of 10 - 150 w frosted globes across the front and above the entry on the north side. They are turned on during business hours. A fluorescent lighted sign at the front, another at the back are on a time clock. Two mercury vapor lights are in the parking lot on the north side of the building.

Inside lighting is manually controlled. Over the lunch counter and in the two high, cut out ceiling areas of the dining room are 48 - 25 w, clear, round bulbs. Along the dark south wall are 6 - 15 w incandescent bulbs, which light from behind some wall decorations. There are 23 - 75 w spot lights around the perimeter of the dining room, recessed into the dropped ceiling. Nine of the 75 w bulbs are left on 24 hours a day for security.

The food preparation area and the restrooms have fluorescent tube fixtures, many of which are left burned out. Exit signs, display case lights, walk in cooler, store room and basement lights make a small contribution and complete the lighting load.

The refrigeration load is significant. There is a milk cooler, lemonade and ice tea machines, pie cooler, pop machine, a walk-in cooler, a walk-in freezer, 4 refrigerators, a freezer and an ice maker.

Electric cooking equipment consists of 2 coffee makers, 3 coffee warmers, a hot chocolate machine, a syrup warmer, soup and bread warmers, waffle griddle, toaster, griddle-range, deep fryer, four more griddles and a microwave. There is a large commercial gas range.

Other electric equipment includes smoke filters, garbage disposal, dish-washer, food mixer, meat cutter, cigarette machine, cash register, two calculators, a TV, a radio and an alarm system.

The HVAC system includes a plug in electric heater in the office. (An old swamp cooler on the roof is not connected). An air conditioner, controlled by thermostat, has exhaust, intake and vent blowers. There is a kitchen exhaust fan. Heat is provided by a 270 MBTU gas furnace controlled by thermostat.

Data

For this one site we have data for 16 months, March 1986 through July 1987. This may be more data than one would care to have but does give enough data to compare and determine which end uses are dependent on such things as weather, daylight hours, hours of operations, or occupancy. The graphs which have been included for this building are the quarterly graphs, #s 1, 2 and 3. These tend to average out any unusual occurences.

The HVAC load for air conditioning, in this gas heated building, increases as the weather warms up. This is the most noticeable change from quarter to quarter.

Also included for this site are some different type graphs, "Peak day vs. Average day" during a month. They do show the difference for HVAC. Lights and food preparation follow the same curve, even on peak days. (In looking at these graphs it is very important to note the KW scale, as it is not the same on all graphs.) In August HVAC has an influence on total load shape. But in April it can hardly be seen.

Auditor's Observations and Recommendations:

1. The most apparent strategy for conservation is lighting change. Most of the incandescent lighting inside and out could be changed to fluorescent globes, fluorescent spot lights and small PLs. This would provide over 66 percent kWh savings on the incandescent lighting load, provide the same or more lumens and would not change the appearance of the restaurant. There would also be a savings on the air conditioning load as there would be less heat generated by the lighting.

2. There is tremendous heat gain in the kitchen - from stoves and griddles and heat from the refrigeration systems. The dining room gains heat from people, lights and hot food. Heat pumps to use the waste heat to heat the hot water would be very efficient in this type environment. The waste heat would be used to heat the water when needed and the cold air exhaust used to cool the interior spaces. The initial expenditure for the heat pump would be high $3,000-8,000. This particular business may not be willing to make this kind of investment at this time.

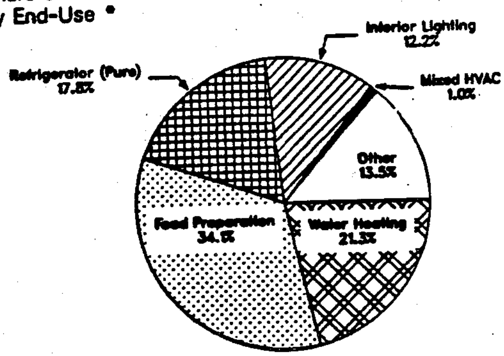
3. The large front windows are cold at night in the winter. However, they face east so only have the morning sun, (occasionally in Seattle) which contributes to needed early-day warmup and does not cause the heat buildup and load on the AC system that west or south facing windows would.

Double-pane windows are expensive and not recommended unless the windows are going to be replaced for other reasons. They are a very small part of the total UA of the building. Double pane windows would be more important if the business was open at night, but it is open from 6 a.m. to 8 p.m.

4. Insulation in the ceiling would keep the building cooler in summer and warmer in winter. There is a cavity so insulation would be a fairly inexpensive option.

SITE 559 3/ 1/87 to 3/31/87

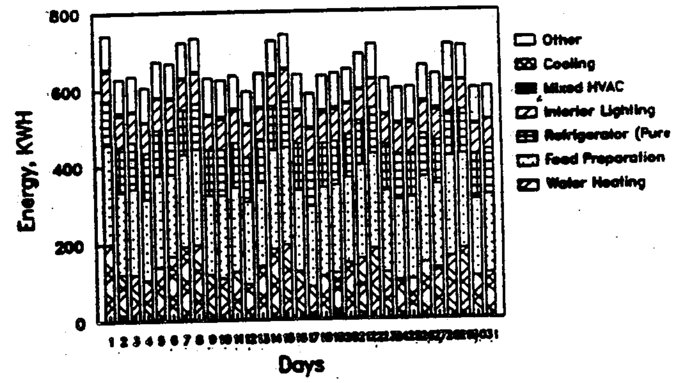
Share of Total Electricity Consumption 20,294 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

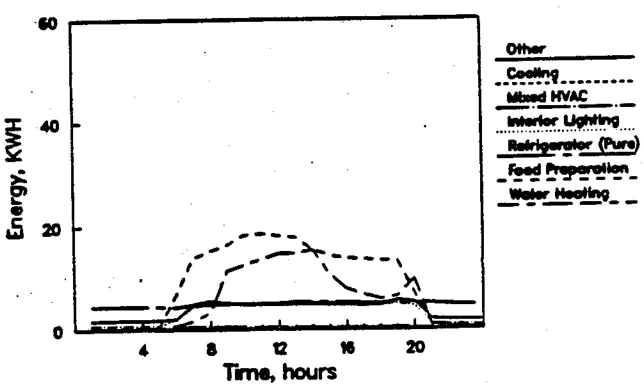
SITE 559 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



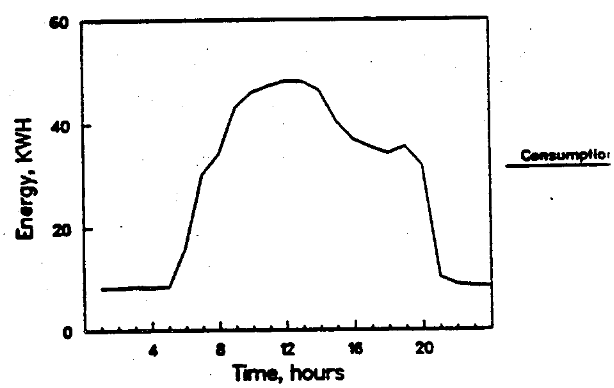
SITE 559 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



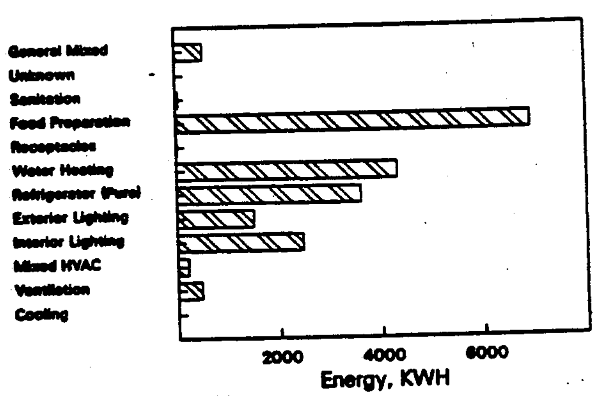
SITE 559 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 559 3/ 1/87 to 3/31/87

Total Consumption by End-Use *

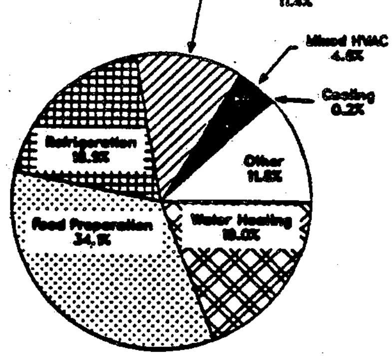


*Adjusted for percentage of good data
Sample size = 1

ELCAP

SITE 559 2nd Quarter 1986

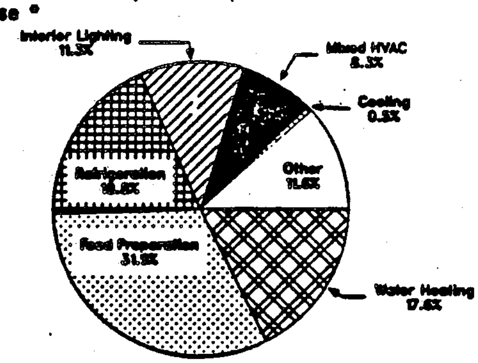
Share of Total Electricity Consumption 59,080 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 559 3rd Quarter 1986

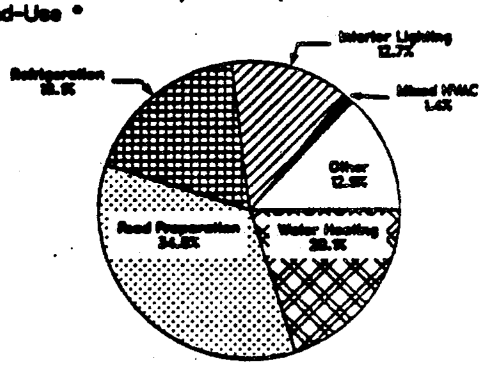
Share of Total Electricity Consumption 62,820 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 559 4th Quarter 1986

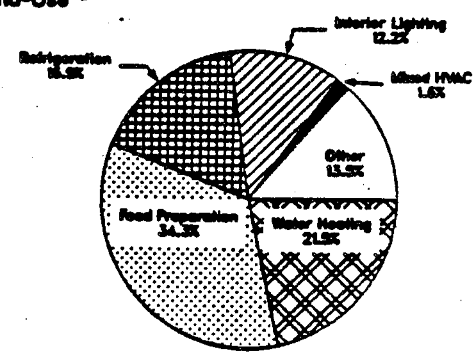
Share of Total Electricity Consumption 56,289 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 559 1st Quarter 1987

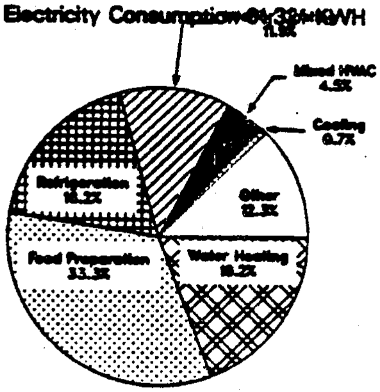
Share of Total Electricity Consumption 58,504 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 559 2nd Quarter 1987

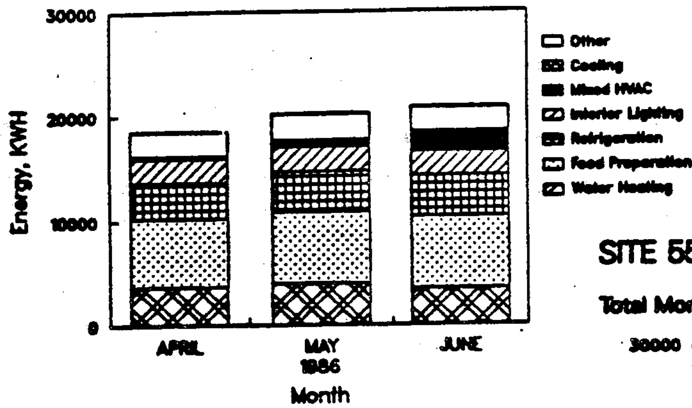
Share of Total Electricity Consumption [illegible] KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

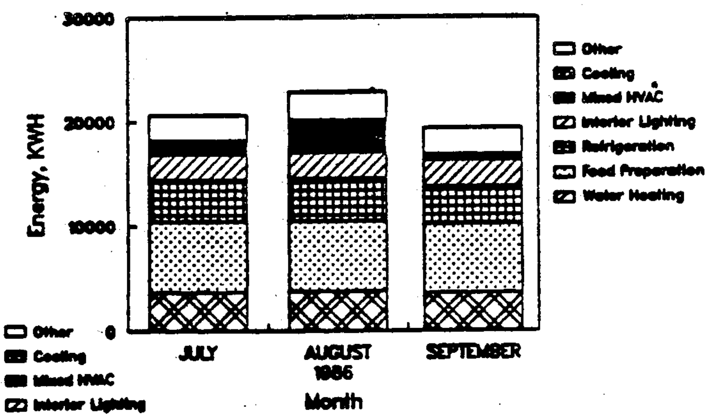
SITE 559 2nd Quarter 1986

Total Monthly Electricity Consumption by End-Use *



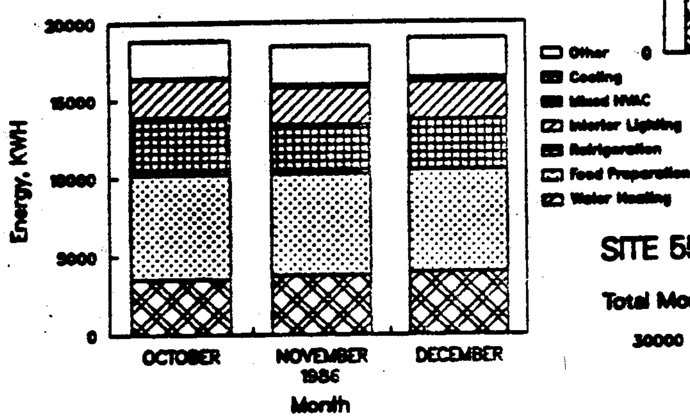
SITE 559 3rd Quarter 1986

Total Monthly Electricity Consumption by End-Use *



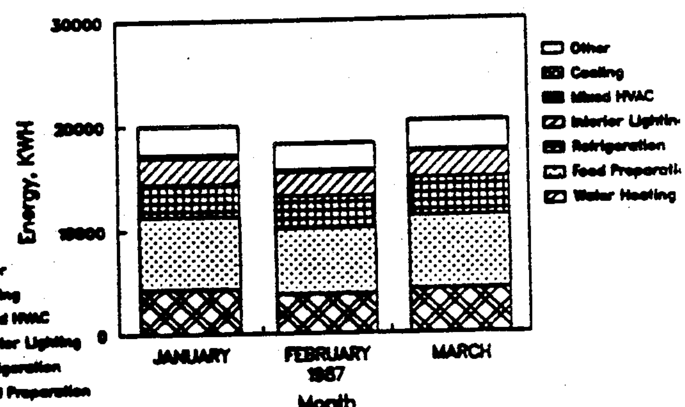
SITE 559 4th Quarter 1986

Total Monthly Electricity Consumption by End-Use *



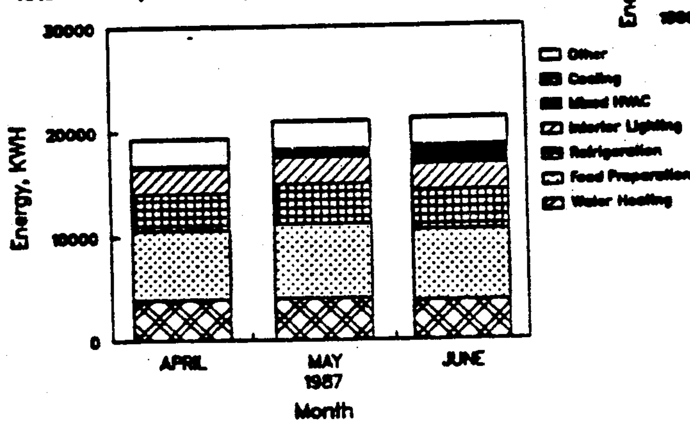
SITE 559 1st Quarter 1987

Total Monthly Electricity Consumption by End-Use *



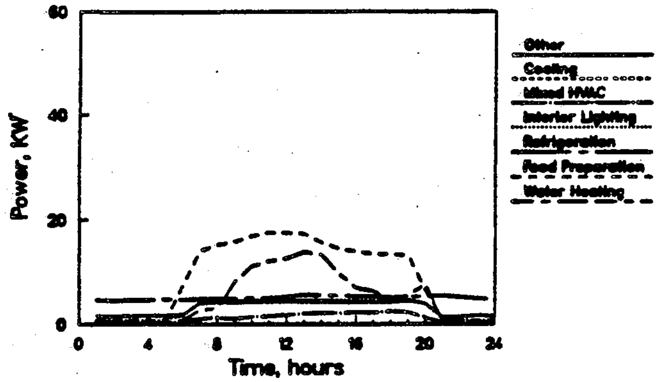
SITE 559 2nd Quarter 1987

Total Monthly Electricity Consumption by End-Use *



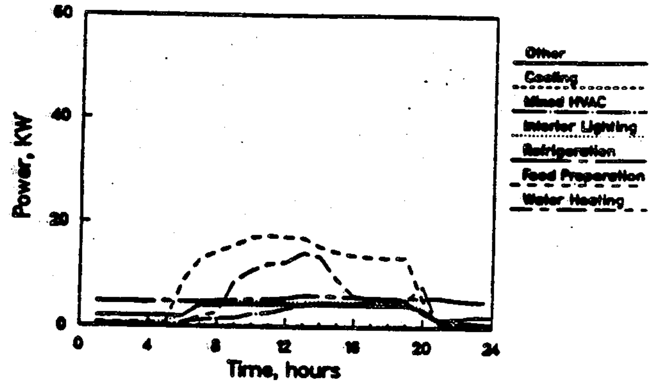
SITE 559 2nd Quarter 1986

Average Daily Electricity End-Use Profile



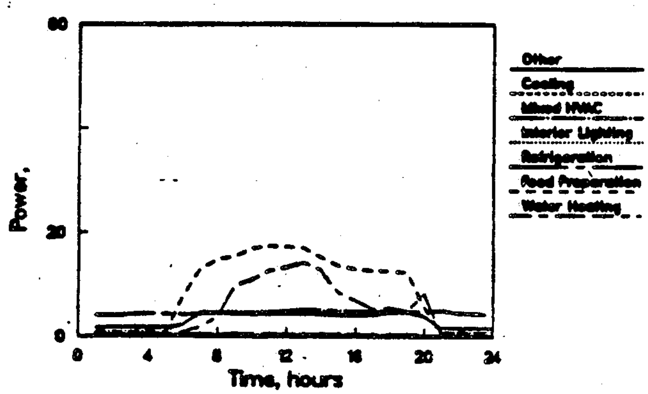
SITE 559 3rd Quarter 1986

Average Daily Electricity End-Use Profile



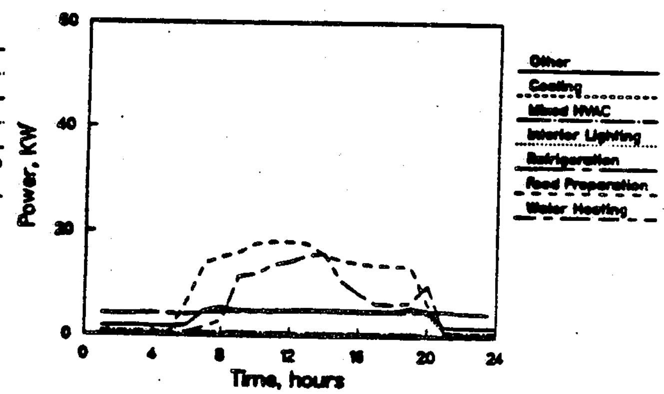
SITE 559 4th Quarter 1986

Average Daily Electricity End-Use Profile



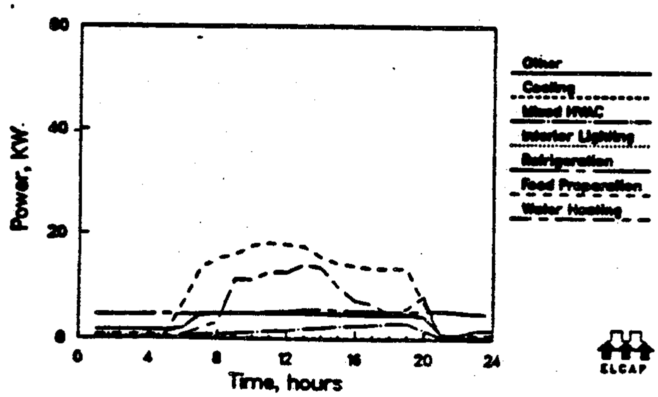
SITE 559 1st Quarter 1987

Average Daily Electricity End-Use Profile



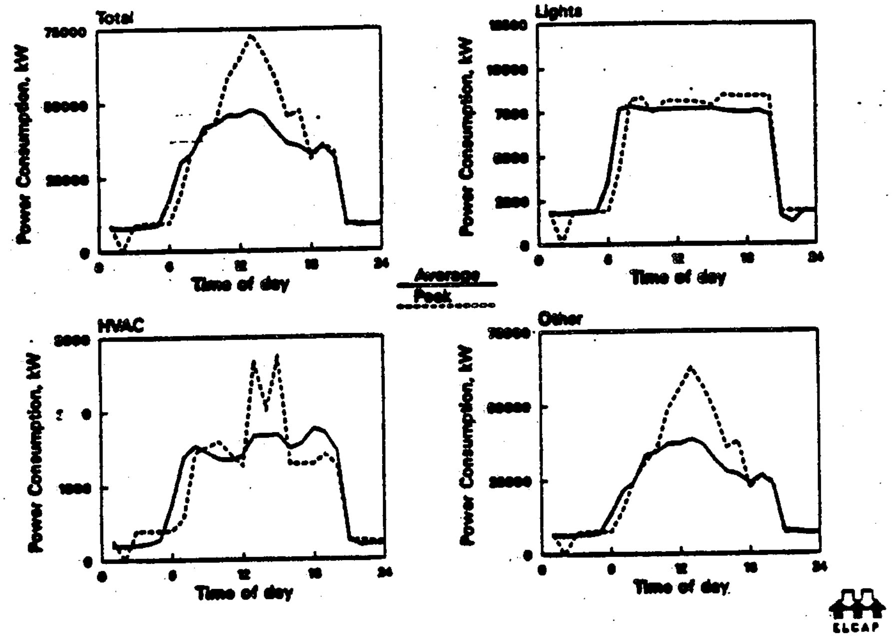
SITE 559 2nd Quarter 1987

Average Daily Electricity End-Use Profile

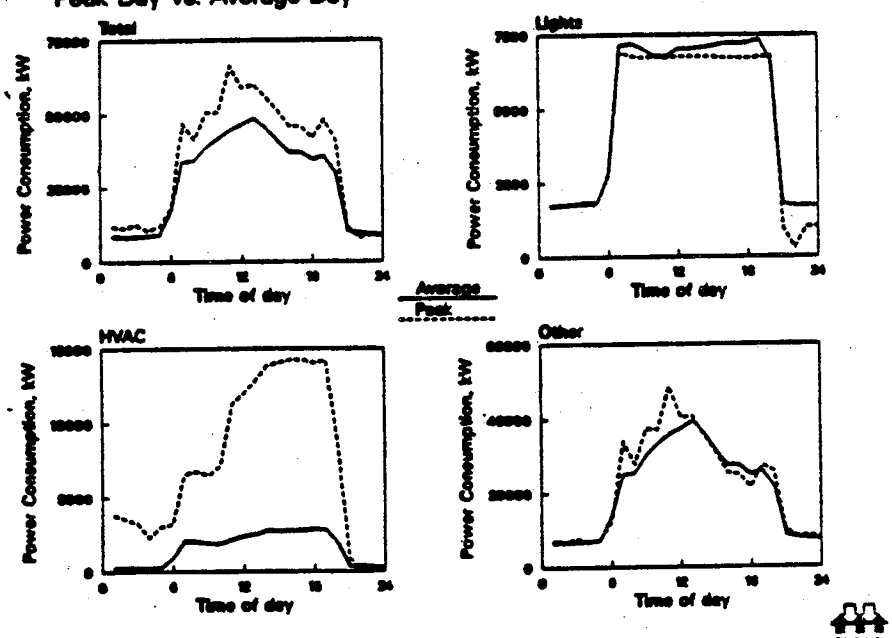


ELCAP

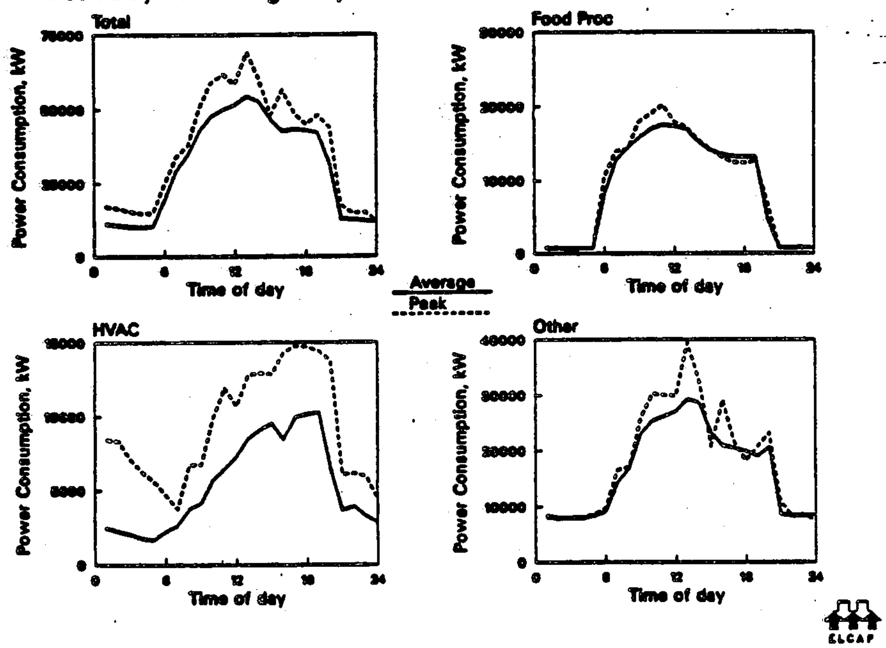
SITE 559 4/ 1/87 to 4/30/87
Peak Day vs. Average Day



SITE 559 5/ 1/86 to 5/31/86
Peak Day vs. Average Day



SITE 559 8/ 1/86 to 8/31/86
Peak Day vs. Average Day



Bldg. ID RES302 | Year Built 1985

Primary Use Retail candy/gift | Square Feet 1134

Hours per week 38

Yearly Consumption - Electrical - SCL Billing | Available End Use Data

1985 - 82,306 - 72.6 kwhs/sq.ft.
1986 - 90,542 - 79.8 kwhs/sq.ft.
1987 - 24,704 - 21.8 kwhs/sq.ft.

July 1986-July 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Wood frame, R-11 insulation
Ceiling	Flat built-up roof, R-19 insulation
Windows	Double pane, wood frame
Sq. ft. windows	101 sq. ft.

BLDG. SYSTEMS

Heating	Air to air heat pump with electric resistance backup.
Air conditioning	Air to air heat pump
Hot water	66 gallon, electric
Refrigeration	2 freezer cases, 1 small refrigerator
Interior lights	2080 w fluorescent 515 w incandescent - 2.3 w/sq.ft.
Exterior lights	450 w incandescent
Equipment I	Food prep
Equipment II	

When first included in the ELCAP study RES 302 was an ice cream store making its own brand of gourmet ice cream on the premises. The business moved in October 1986, shortly after the monitoring equipment was installed. It had become so successful larger quarters were needed. The small 1,134 square foot shop is now a candy store/gift shop. The original ice cream continues to be sold by the new owner who features her homemade fudge as her featured product. High quality chocolates, assorted other candies, gift items, party goods, dolls, stuffed animals and other trinkets are also carried.

The building housing the shop contains a row of interesting shops and international restaurants; a Chinese restaurant on the north side of the shop and a Japanese restaurant on the south side. Only the candy shop is included in ELCAP.

Open hours are noon to 6 pm Monday through Thursday, noon to 7 pm Friday and Saturday, closed on Sundays and holidays. The owner may come in early or stay after closing to make the fudge, arrange the displays or take care of inventory.

During the early afternoon customer traffic is light, the store often has no customers. A grammar school is located across the busy street, but the quality items are out of the price range for most of the children. The targeted customer populations are the university students and working people living in the densely populated residential area surrounding the small business district. The store is staffed by one employee, occasionally two. Business is cyclical. Just before the big "candy holidays; e.g., Easter, Valentine's Day, the store can be very busy.

Small tables and chairs have been set out on the sidewalk directly in front of the store for ice cream service in the summer.

The seventeen foot wide store is sixty-five feet long. The building was completed in 1983 and met Energy Code requirement of the time. Exterior wall, a very small part of the shop, is wood frame with three inches batt insulation, R11. The flat roof ceiling has six inches of batt insulation, R19. The front door is a half wood, half small window pane, Dutch door. The door and windows which are double pane face directly west. There is a mini blind about three feet in from the window, making a backdrop for the window display and for the neon sign. The floor is slab on grade. The sales counter and candy cases run down the center. The work area is along the south wall behind this long display. The north wall is used for display of cards and gifts. Toward the back the display area widens which offers more opportunity to show some of the larger items. There is a storage/office area behind the beaded hanging in the doorway. In here steel shelves line the walls and a small desk area is built in. The 66 gallon electric water heater and the transformer for the building sit on the floor, taking up a lot of valuable space. A rest room, shared with the north side restaurant is off a small hall accessed through the store room. The rest room has its own 6 gallon hot water heat.

Each retail space has an air to air heat pump on the roof. It has venting and air supply fans with electric resistance heat backup. The interior lights are fluorescent ceiling lights in the store, the storage area and the hall. Incandescent lights are used in the three track lights for the window display and in the rest room. There is one neon sign in the window. Exterior lighting is a 150w flood and 300w sign lights. The shop is directly on the well-lit front sidewalk and has no direct exit to the back alley area.

Only one month of data has been provided for this site, March 1987, a mild month in Seattle. Graphs 1 and 5 show little demand for heating 1 percent of total consumption but 25.3 percent for air conditioners and venting. In the winter there may be a decrease in air conditioning and venting. In the summer there would be a great increase to compensate for the heat generating processes in the store, plus the solar gains.

As the month progresses and the weather warms up a steady increase can be seen in the HVAC load. Graph #2. It also shows an increased water heating load reflecting the unusual work activity beyond regular store hours.

Graph #3 shows the heat being used just before the shop opens. The HVAC system handles the heated air and mirrors the use of the heat. The other systems then start working out and the heating load disappears. After closing there is another jump in the HVAC system.

Graph #4 clearly shows the high start up load which then drops to a fairly steady rate until closing time when hot water for clean up causes a small peak. Consumption then returns to its steady night time level.

The tenant at the time of the original survey had a central refrigeration compressor which was coded for refrigeration along with the small undercounter refrigerator. The present tenant still uses the small refrigerator which shows up on Graph #5. However, there is now a large refrigerator and 2 freezer cases plugged into the receptacles. This is one reason the receptacle load is so large.

Auditor's Observations: The nature of the business demands it be kept at a reasonably cool temperature all year round. Cooling becomes of more concern than heating. The two "warm" businesses on either side, the 66 gallon water heater, display lights, refrigerator, freezer case, waffle cone maker, espresso machine, candy kettle, mixers, heated nut case and other small equipment all add heat to this small shop. The only windows face west for unobstructed solar gain during the afernoon.

Since hot water is not needed very often a small 6 gallon tank under the food prep sink or an instantaneous water heater would eliminate the great standby heat loss from the big tank. Removal of the large, poorly placed tank would also give some valuable space to the storeroom.

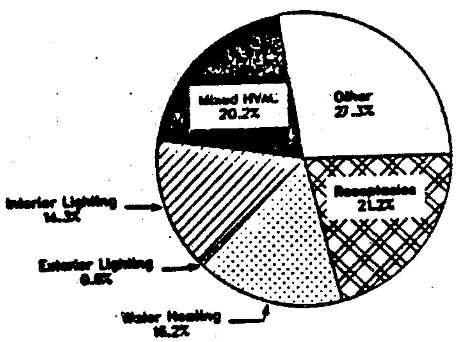
The inside blind behind the window shelf helps, but an awning or shade on the outside would be more effective in preventing the afternoon sun heating up the store.

When it is hot, it is too hot to sit at the unshaded tables out front. When it is cold, no one wants to sit out eating ice cream. Umbrellas or other innovative shading would improve this. The two very small maple trees planted in front of the stores on either side of this shop are several years away from providing the candy store any shade.

Fluorescent lighting can be used in the track lights and other incandescent fixtures. It would maintain or improve the quality of the light which is an important consideration in this retail business. It would also decrease the heat level.

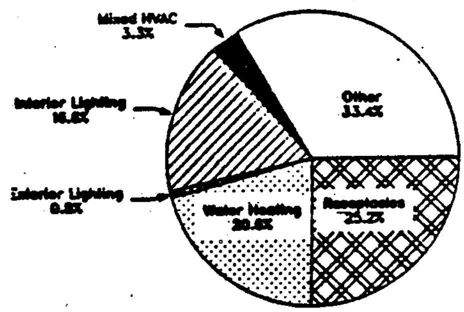
SITE 457 8/ 1/86 to 8/31/86

Share of Total Electricity Consumption 6,458 KWH by End-Use *



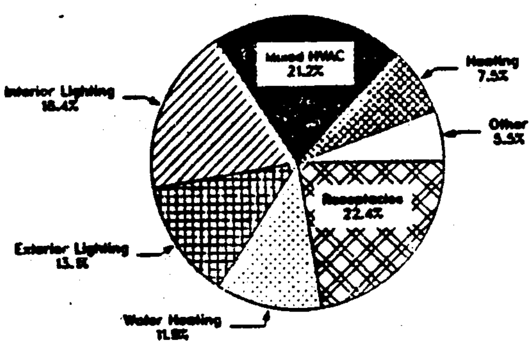
SITE 457 9/ 1/86 to 9/30/86

Share of Total Electricity Consumption 4,971 KWH by End-Use *



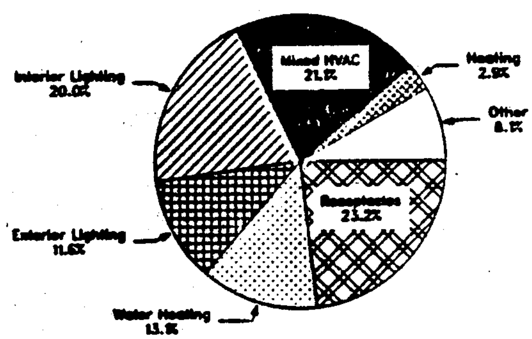
SITE 457 11/ 1/86 to 11/30/86

Share of Total Electricity Consumption 2,425 KWH by End-Use *



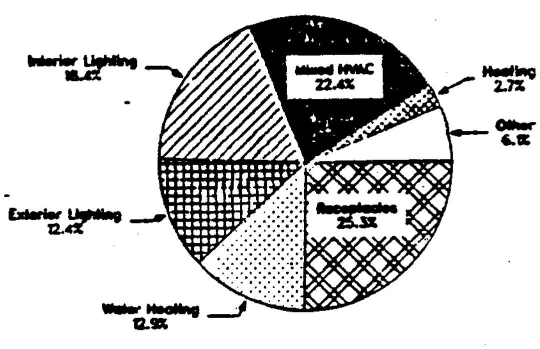
SITE 457 12/ 1/86 to 12/31/86

Share of Total Electricity Consumption 2,322 KWH by End-Use *



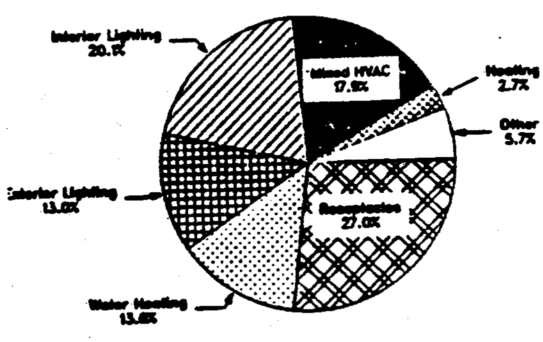
SITE 457 1/ 1/87 to 1/31/87

Share of Total Electricity Consumption 2,161 KWH by End-Use *



SITE 457 2/ 1/87 to 2/28/87

Share of Total Electricity Consumption 1,822 KWH by End-Use *

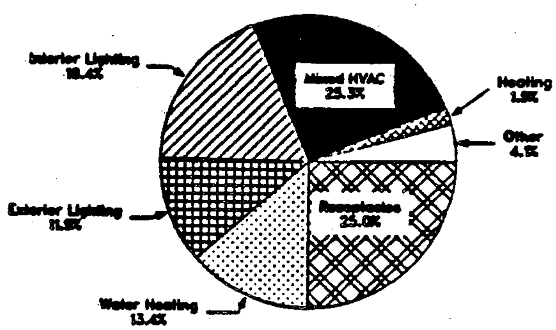


* Adjusted for percentage of good data
Sample size = 1

ELCAP

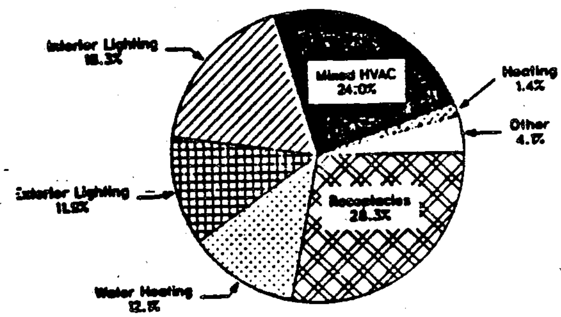
SITE 457 3/ 1/87 to 3/31/87

Share of Total Electricity Consumption 2,193 KWH by End-Use *



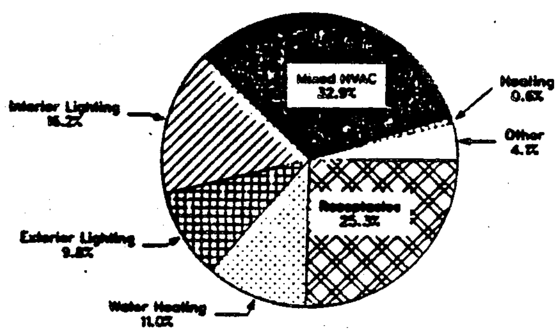
SITE 457 4/ 1/87 to 4/30/87

Share of Total Electricity Consumption 2,071 KWH by End-Use *



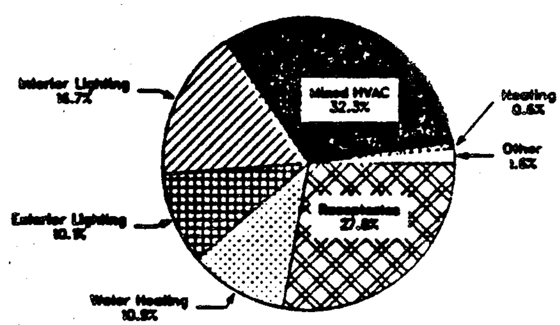
SITE 457 5/ 1/87 to 5/31/87

Share of Total Electricity Consumption 2,537 KWH by End-Use *



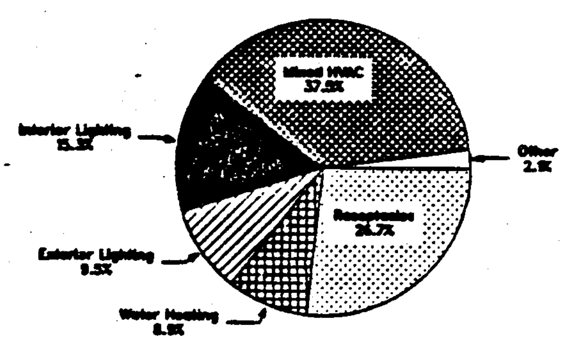
SITE 457 6/ 1/87 to 6/30/87

Share of Total Electricity Consumption 2,358 KWH by End-Use *



SITE 457 7/ 1/87 to 7/30/87

Share of Total Electricity Consumption 2,513 KWH by End-Use *

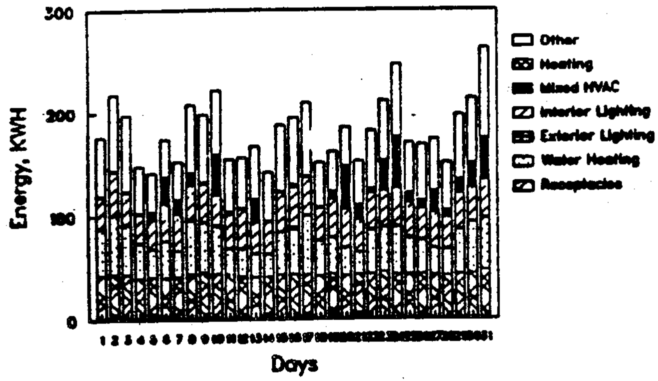


* Adjusted for percentage of good data
Sample size = 1

LLCAP

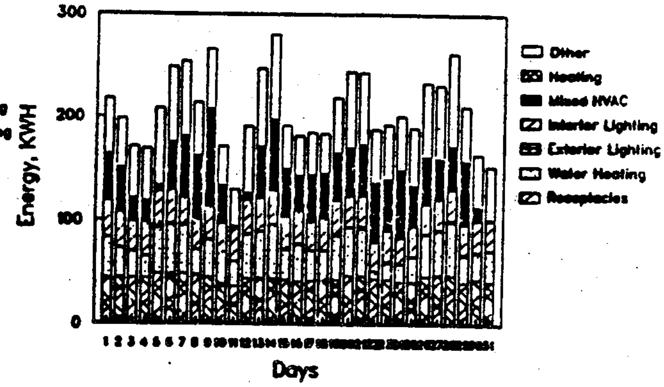
SITE 457 7/ 1/86 to 7/31/86

Total Electricity Consumption by End-Use *



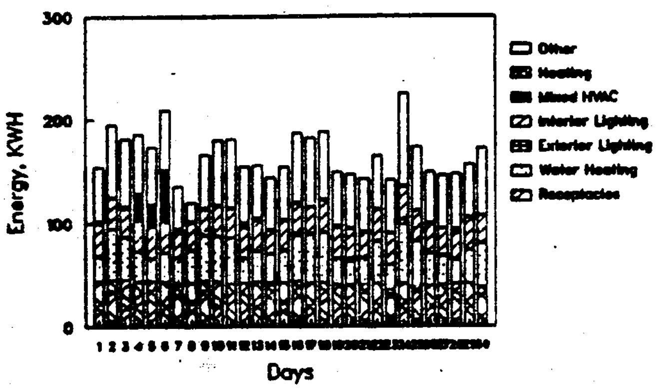
SITE 457 8/ 1/86 to 8/31/86

Total Electricity Consumption by End-Use *



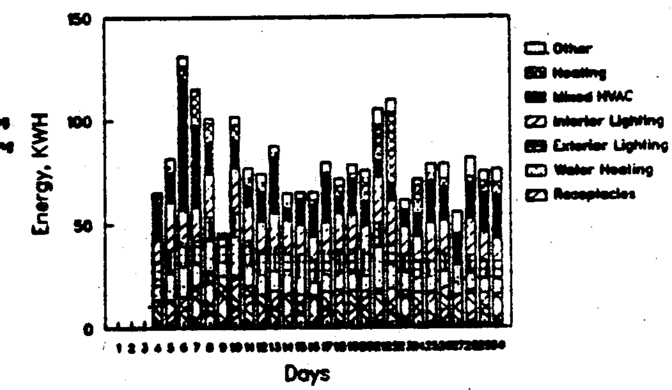
SITE 457 9/ 1/86 to 9/30/86

Total Electricity Consumption by End-Use *



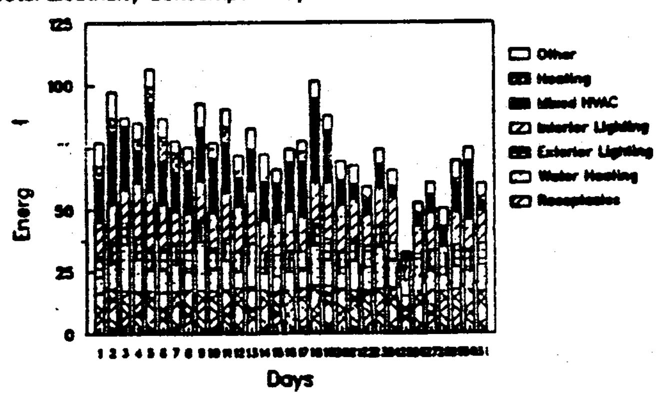
SITE 457 11/ 1/86 to 11/30/86

Total Electricity Consumption by End-Use *



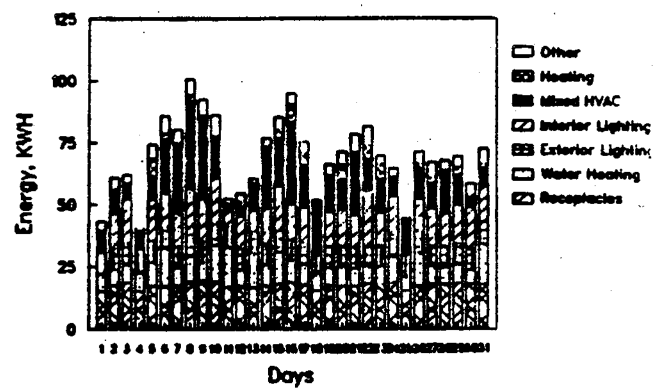
SITE 457 12/ 1/86 to 12/31/86

Total Electricity Consumption by End-Use *



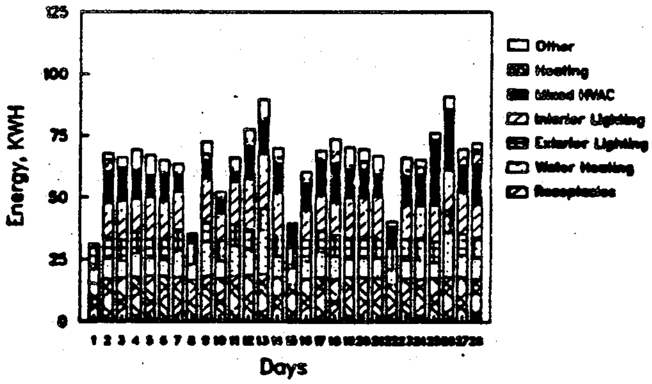
SITE 457 1/ 1/87 to 1/31/87

Total Electricity Consumption by End-Use *



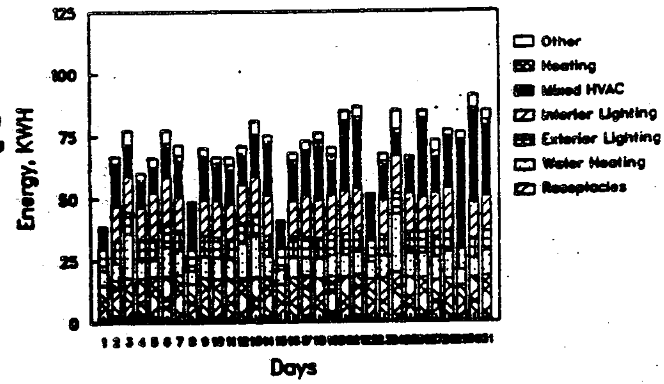
SITE 457 2/ 1/87 to 2/28/87

Total Electricity Consumption by End-Use *



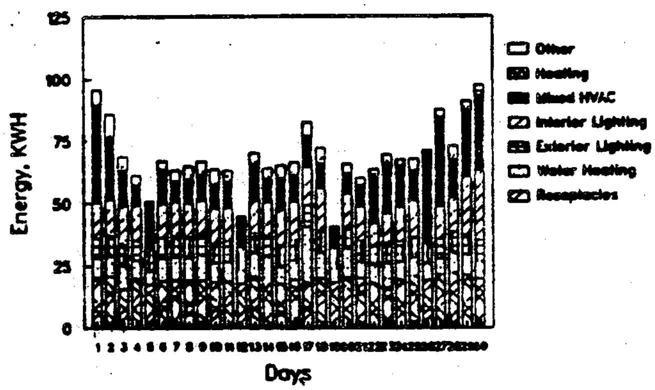
SITE 457 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



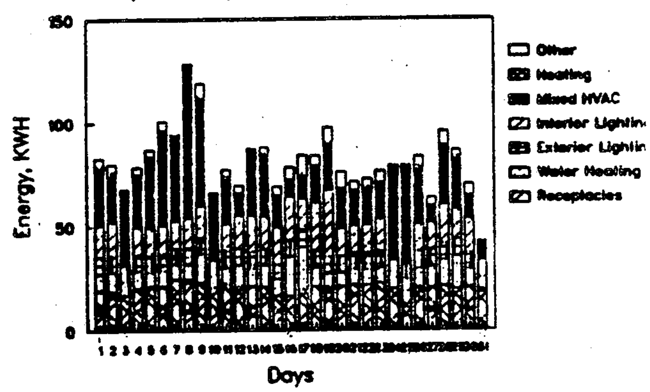
SITE 457 4/ 1/87 to 4/30/87

Total Electricity Consumption by End-Use *



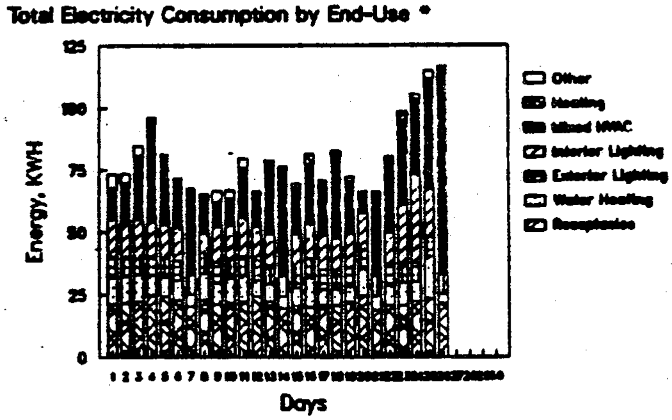
SITE 457 5/ 1/87 to 5/31/87

Total Electricity Consumption by End-Use *



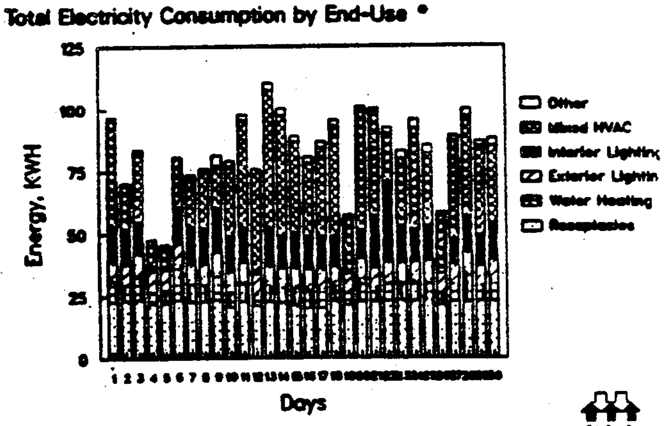
SITE 457 6/ 1/87 to 6/30/87

Total Electricity Consumption by End-Use *



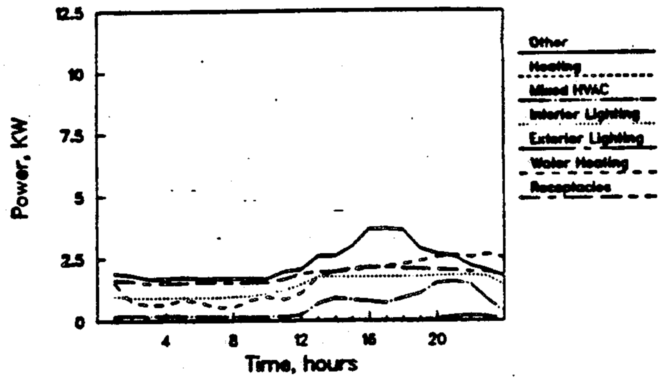
SITE 457 7/ 1/87 to 7/30/87

Total Electricity Consumption by End-Use *



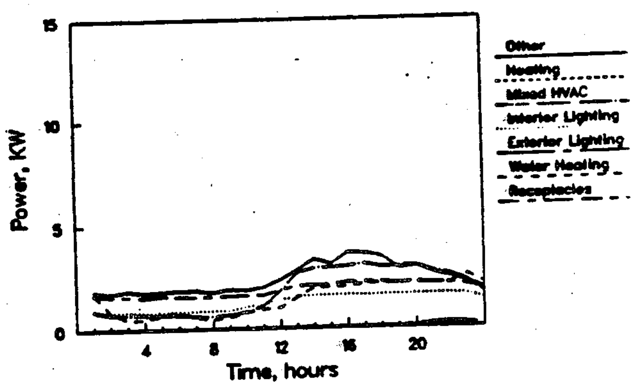
SITE 457 7/ 1/86 to 7/31/86

Average Daily Electricity End-Use Profile



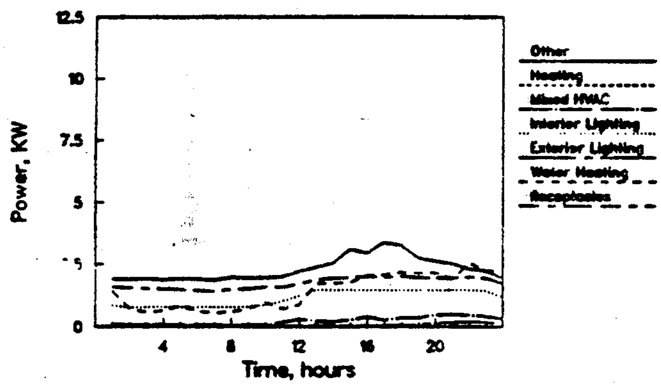
SITE 457 8/ 1/86 to 8/31/86

Average Daily Electricity End-Use Profile



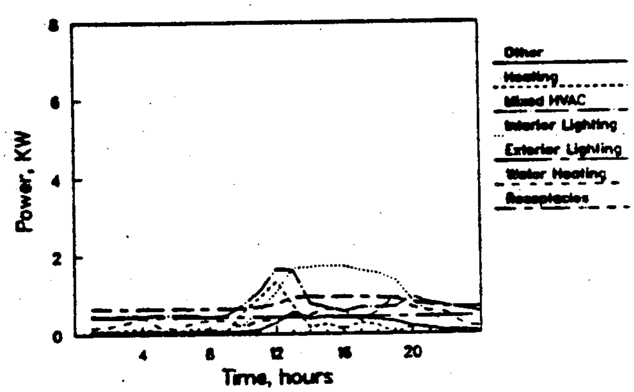
SITE 457 9/ 1/86 to 9/30/86

Average Daily Electricity End-Use Profile



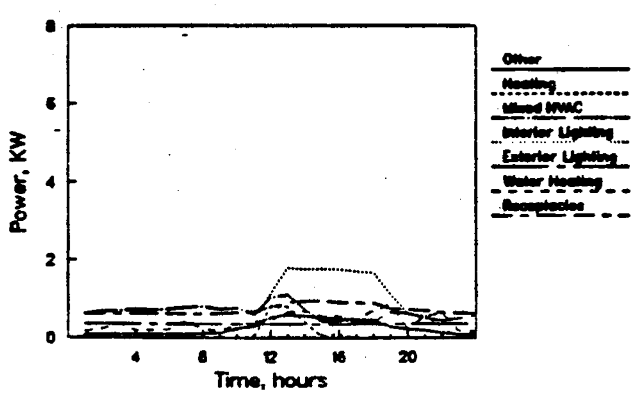
SITE 457 11/ 1/86 to 11/30/86

Average Daily Electricity End-Use Profile



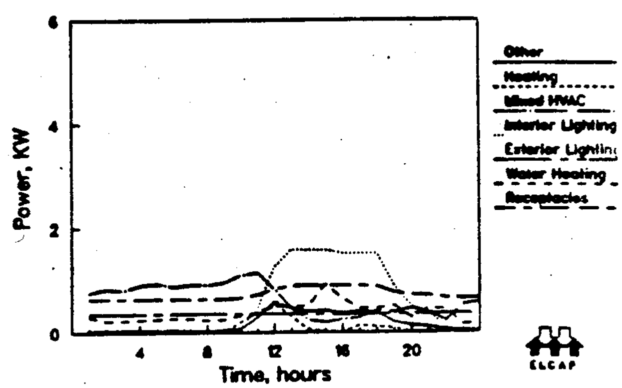
SITE 457 12/ 1/86 to 12/31/86

Average Daily Electricity End-Use Profile



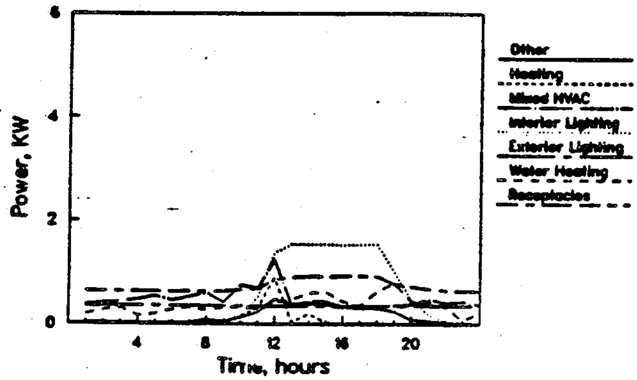
SITE 457 1/ 1/87 to 1/31/87

Average Daily Electricity End-Use Profile



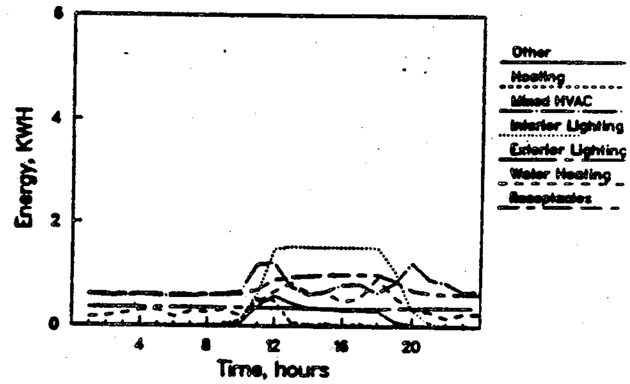
SITE 457 2/ 1/87 to 2/28/87

Average Daily Electricity End-Use Profile



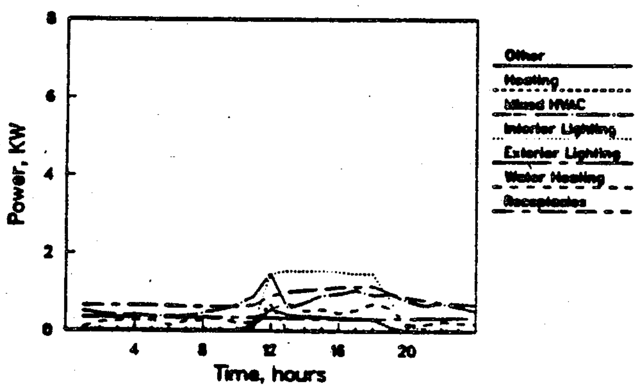
SITE 457 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



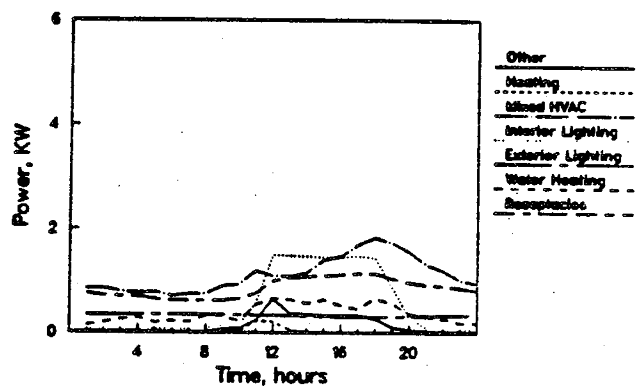
SITE 457 4/ 1/87 to 4/30/87

Average Daily Electricity End-Use Profile



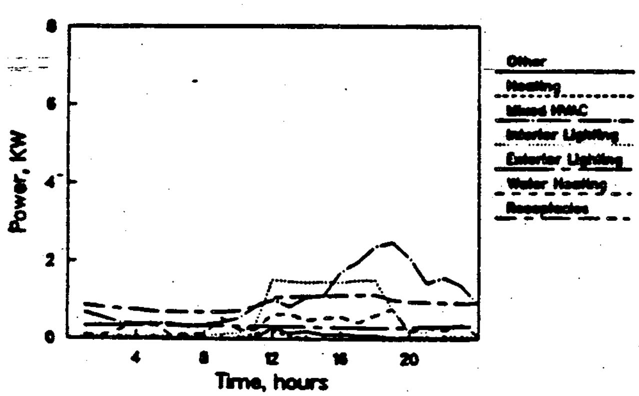
SITE 457 5/ 1/87 to 5/31/87

Average Daily Electricity End-Use Profile



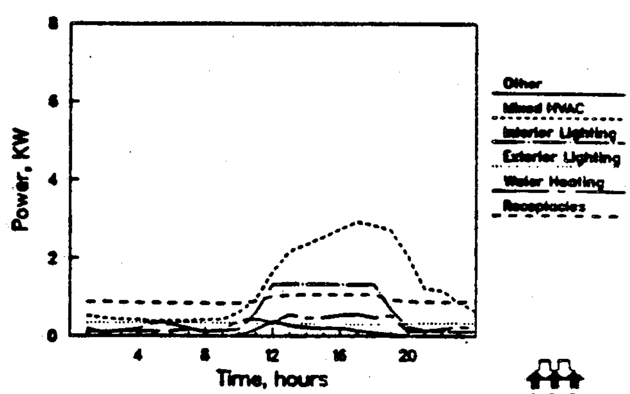
SITE 457 6/ 1/87 to 6/30/87

Average Daily Electricity End-Use Profile



SITE 457 7/ 1/87 to 7/30/87

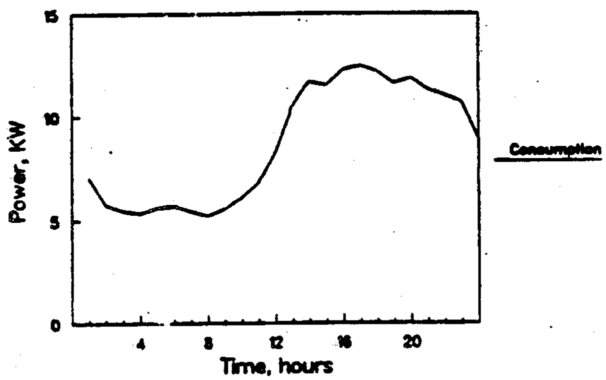
Average Daily Electricity End-Use Profile



ELCAP

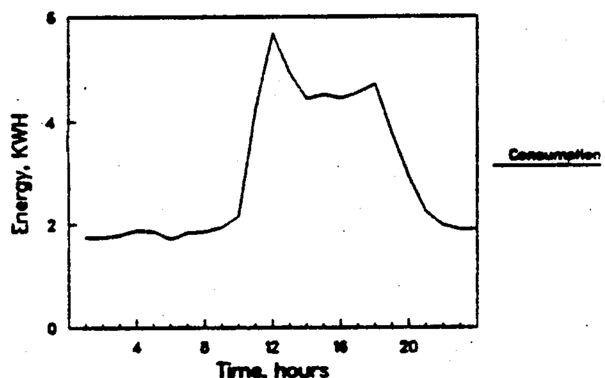
SITE 457 8/ 1/86 to 8/31/86

Average Daily Total Electricity Use

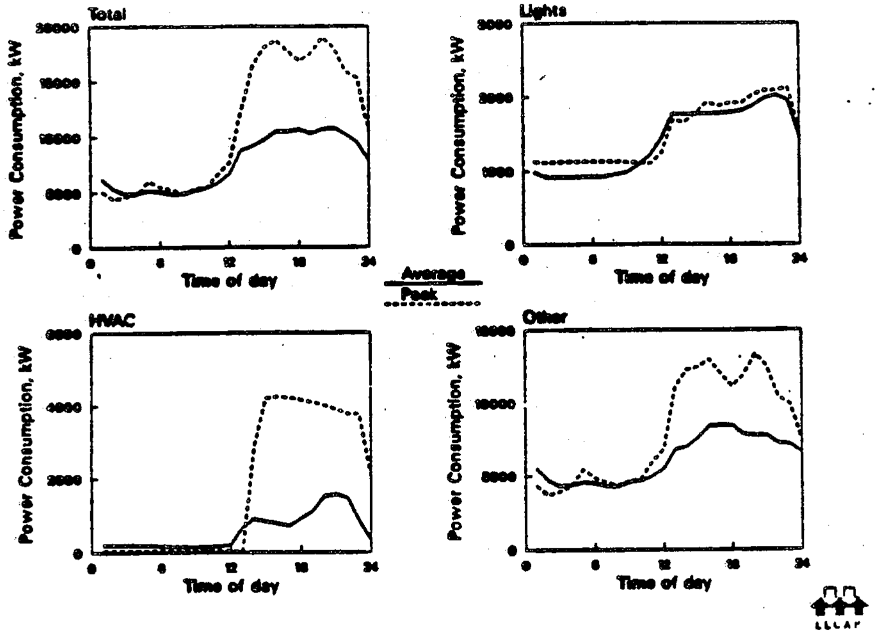


SITE 457 3/ 1/87 to 3/31/87

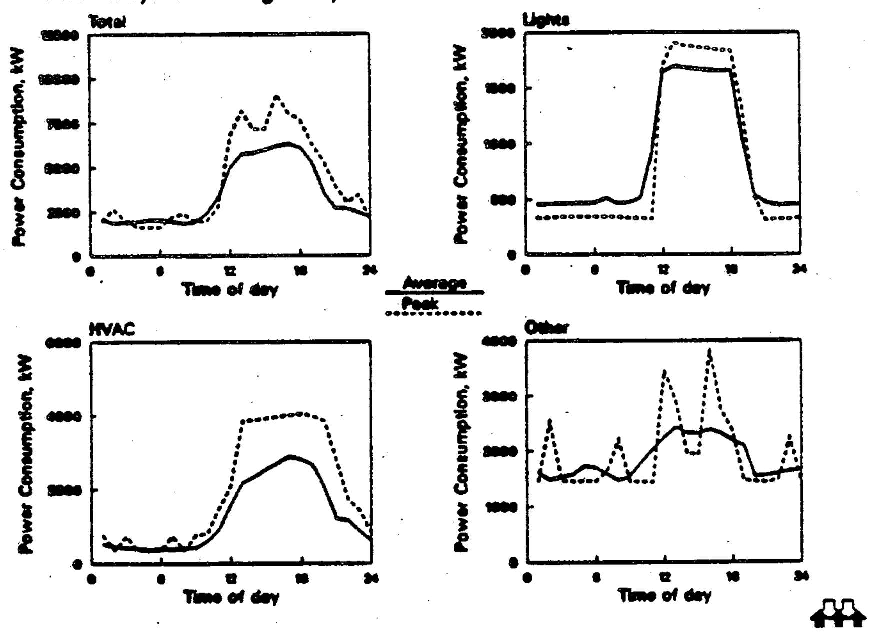
Average Daily Total Electricity Use



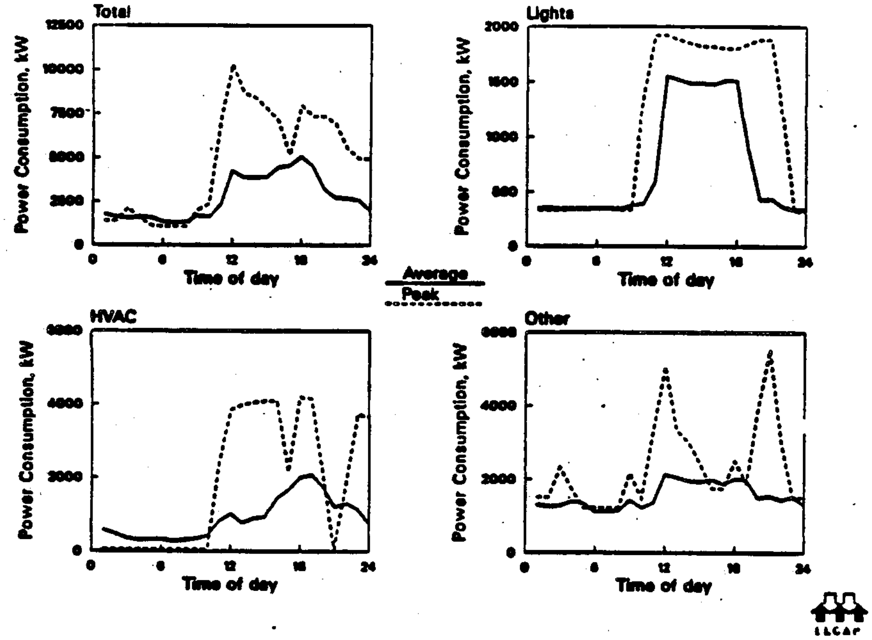
SITE 457 7/ 1/86 to 7/31/86
Peak Day vs. Average Day



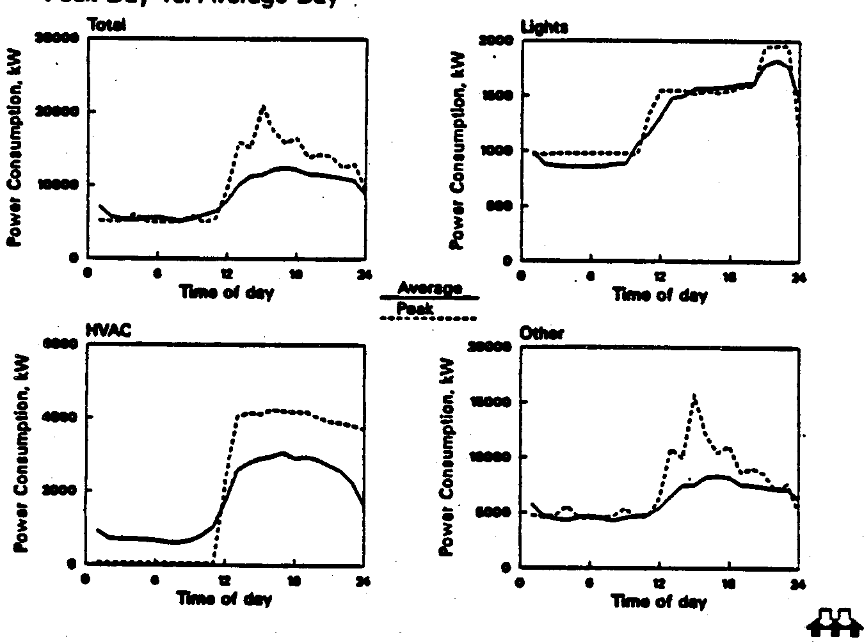
SITE 457 7/ 1/87 to 7/31/87
Peak Day vs. Average Day



SITE 457 6/ 1/87 to 6/30/87
Peak Day vs. Average Day



SITE 457 8/ 1/86 to 8/31/86
Peak Day vs. Average Day



Bldg. ID RES 303

Year Built 1981

Primary Use Fast Food Restaurant

Square Feet 2,777

Hours per week 124

Yearly Consumption - Electrical - SCL Billing

1985 - 270,400 - 97.4 kwhs/sq.ft.
1986 - 280,320 - 100.9 kwhs/sq.ft.
1987 - 262,880 - 94.7 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Wood frame, brick veneer, R-11 insulation
Ceiling	Flat built up, R-19 insulation
Windows	Double pane, metal frames
Sq. ft. windows	314 sq. ft.

BLDG. SYSTEMS

Heating	Air-to-air heat pump, forced air gas back up
Air conditioning	Heat pump
Hot water	Gas
Refrigeration	19,673+ w
Interior lights	1,860 w fluorescent 3,225 w incandescent - 1.8 w/sq.ft.
Exterior lights	550 w fluorescent 700 w incandescent + parking lot lights and signs
Equipment I	Food preparation
Equipment II	

RES303 is a typical restaurant in the very competitive fast food burger business. It is a 2,777 sq. ft. frame with brick veneer building built for this chain in 1981. It is located on a busy street in the front of a family oriented shopping center. A junior high school and a high school are within easy walking distance. Business hours are 6:30 a.m. every morning, except Sunday, which is 7 a.m. until midnight Sunday through Thursday. It is open until 1 a.m. Friday and Saturday nights. The only days it is closed are Christmas and a half day on New Year's Day. The restaurant may serve up to 1000 customers a day and have twelve people working at one time. The average is about fifteen customers at a time and six employees. At lunch time, turnover is very fast with each customer spending a minimal amount of time in the restaurant. At other times they stay longer.

The staff tends to be young with limited experience in operation and maintenance of the building and employee turnover is high. Outside contractors service the equipment and lighting.

The building is designed like the chain's other restaurants. The dining room is at the front, facing east, occupying 50 percent of the space. The counter runs across the width of the restaurant, separated from the kitchen by a high divider which provides work areas for dispensing drinks and ice cream, picking up and packaging hot food orders. The drive-up window is at the south end of the counter, restrooms are at the north end of kitchen area. There are a walk-in refrigerator and a walk-in freezer to the back of the kitchen. This part of the building's construction has R-39 insulation in the ceiling and walls.

The rest of the building has R-11 batt insulation in the walls, R-19 in the flat, built up roof. The floor is concrete slab on grade. The 314 sq. ft. of double pane window are all in the dining area or drive-up window as is the 60 sq. ft. of single pane glass doors. There are no window coverings.

Major electric loads are the heat pumps for heating and cooling, ventilation, refrigeration/freezing, broiler, food preparation equipment, inside and outside lighting.

Some of the major loads are fueled by natural gas: back up heat for the four heat pumps, domestic hot water, charbroiler, steam table and deep fat fryer.

The interior lights are mostly fluorescent, forty-three 75w incandescent bulbs are used in decorative fixtures in the dining room. The large signs on the exterior and the 8 ft. x 8 ft. sign high on a pole so it can be seen for miles, have high output fluorescent tubes. There is a photocell installed, but is not being used. There is one high intensity discharge light on a pole in the parking area. Exterior lighting is supplemented by street lights and the shopping center parking lot lights.

End use loads are sorted out with little mixed load except for the outlets into which various equipment can be plugged.

Data:

The reliable data for RES 303 is typical for a fast food restaurant. Graph #1 shows even in March the cooling and venting load is high because of the interior lights and the open cooking area.

Graph #2 shows a fairly consistent load for each end use with only slight variations, except for the exterior lighting. The human factor is responsible for this erratic behavior of a load that should be very steady. With shift changes and different personnel responsible for controlling the lights this is almost inevitable--and costly.

Graph #3 shows the resonable operation of a restaurant. The food preparation jumps up just before opening and continues a gradual decrease until closing when it drops again. Interior lighting shows a very even line from the time they are turned on until closing, cooling load increases as the restaurant heats up during the midday then drops again as the day cools off. The exterior lights are turned on for early business hours then turned down during the day and turned up again in the evening. The photocell is not being use. Because the morning peak is only half of the evening peak for the outdoor lighting, they may not always be turned on in the morning. This would help explain the erratic daily consumption. The 3D graph for November 1985 defines the use more clearly. There are some periods of missing data, but we can see how the lights are turned on or off each day. The heat pumps have gas heater back up. Much of the cooking is by gas and the hot water heater is gas. We do not have hourly end uses for these.

Auditor's Observations and Recommendations:

The cooking processes add heat to the building. Handling this is of more concern than trying to heat the building on cold days. Exhaust fans and outside air supply fans are the major methods used. These are supplemented by the heat pumps. Only in the very coldest weather are the gas back up burners needed to supply heat.

1. Because of the high employee turn over, continuing instruction should be given in the care and regulation of the HVAC system. During most of the year ventilation system could be used at night rather than the air conditioning.

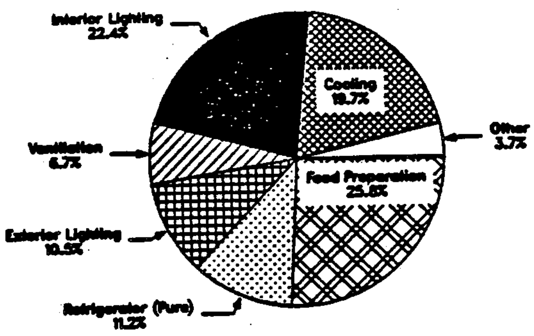
2. As new lighting technologies develop, attention should be paid to the lighting loads. For example, the interior lighting levels and the desired appearance could be maintained with the use of fluorescent lights rather than incandescent in the decorative fixtures.

3. Repair of the photocell for exterior lights and timers for interior lights would eliminate the need for people to remember to turn them on and off.

4. The building is used mainly in day time hours and is fairly well insulated; therefore, no shell measures are recommended.

SITE 9 3/ 1/87 to 3/31/87

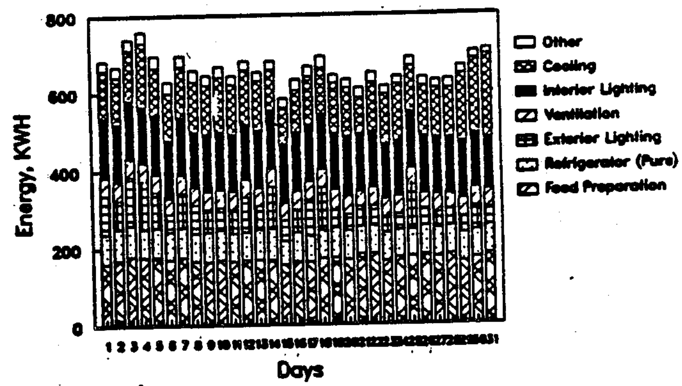
Share of Total Electricity Consumption 20,526 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

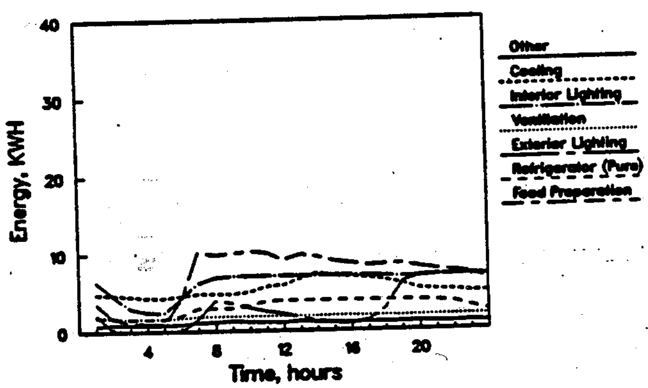
SITE 9 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



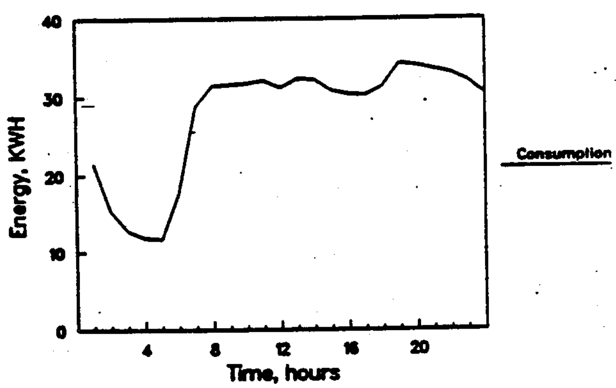
SITE 9 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



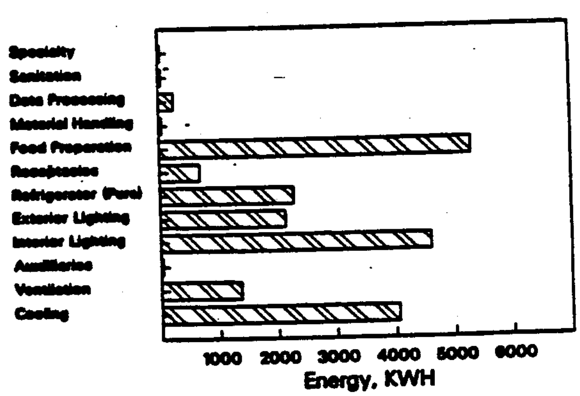
SITE 9 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 9 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID RES401	Year Built 1983
Primary Use Restaurant	Square Feet 7,190
Hours per week 72	

Yearly Consumption - Electrical - SCL Billing

1985 - 375,660 - 52.2 kwhs/sq.ft.
1986 - 339,660 - 47.2 kwhs/sq.ft.
1987 - 388,800 - 54.1 kwhs/sq.ft.

Available End Use Data

July - Oct. 1987

BLDG. CHARACTERISTICS

Floor	Concrete, slab on grade
Walls	Wood frame, R-19 insulation
Ceiling	Flat built-up roof R
Windows	Double pane, wood frame
Sq. ft. windows	1,141 sq. ft.

BLDG. SYSTEMS

Heating	Gas, forced air
Air conditioning	Direct expansion
Hot water	Two 90 gal. gas, circulating pump
Refrigeration	> 21,116w
Interior lights	5,160 w fluorescent 4,686 w incandescent - 1.37 w/sq.ft.
Exterior lights	3,504 w fluorescent 1,800 w incandescent
Equipment I	Food prep
Equipment II	Sanitation

RES 401 was built in 1983 and had a wood fired, open pit barbeque as its dominant feature when first included in ELCAP. In the summer of 1986 the restaurant was sold to another corporation and in place of the open pit a long salad bar became the focus of the dining room. Decorative wall paper, lots of brass and glass, upolstered seating and green plants give a different ambiance. Decor is given special attention in order to attract a large segment of the population to the full service restaurant which depends on a large volume of customers for its profit.

The new restaurant is open seven days a week from 11 a.m. to 9 p.m., 10 p.m. on Fridays and Saturdays. The lunch and dinner crowds are drawn from the near by shopping center and business buildings which are within walking distance. It is located on a very busy street and customers also drive to the restaurant.

The wood frame walls are stucco finished on the outside and have R-19 batt insulation. The flat built-up roof has R-28 insulation. The floor is concrete slab on grade. It is carpeted in the dinning area, entry is ceramic floor tile and kitchen is just concrete. Windows are double pane in wood frame.

HVAC equipment is located on the roof. Heat is supplied by five forced air gas furnace units, air conditioning by five electric air conditions with supply and heat rejection fans. The original restaurant had two additional exhaust fans, one of which was closed off when the open pit was removed.

The central refrigeration system has two heat exchangers, six condenser fans and a defrost cycle. The two 90 gallon gas hot water heaters have preheated water supplied by a heat recovery box for the condensers.

The present owners enlarged the dining room by moving the entire front, south facing, window wall out 10½ feet. The venting system was modified, eliminating the exhaust for the old barbeque pit. Some new equipment was installed in the kitchen. Some food preparation equipment was changed slightly, but for the most part the same type of equipment is being used; electric grill, warming oven, steam table, microwave, coffee makers, slicers and mixers. There is an electric fan for the gas convection oven and electric controls for the gas french frier. Refrigeration has had only minor changes. The large walk-in freezer and walk-in cooler are the greatest part of this load.

Interior lighting in the dining room and rest rooms is incandescent. The kitchen has mostly fluorescent ceiling fixtures. Exterior lighting is incandescent, most of it on a time clock. The electric signs are on a photo cell.

Data:

The 3D graphs for the period of July 1987 through November 1987 show how the electric load is driven by the HVAC system which operates all year but is highest in the warm weather. (Heat is forced air gas.) The internal gains are great: cooking, steam table, continued high occupancy and solar gains through the south and west windows. When the weather is warm all this internal heat requires more air conditioning. The #1 graphs also show the percentage change of total load for HVAC as the weather cools. In August the temperature from the third to the ninth (except for the fifth) averaged 68 degrees - 71 degrees. On the 30th and 31st it averaged 70 degrees and 73 degrees. Graph #2 for August shows the increase in HVAC on those days the temperature increases. The #4 graphs for each month show the same general shape for total electric load. However, the August load is larger and starts earlier in the day due to the increase in the air conditioning.

Auditor's Observations and Recommendations;

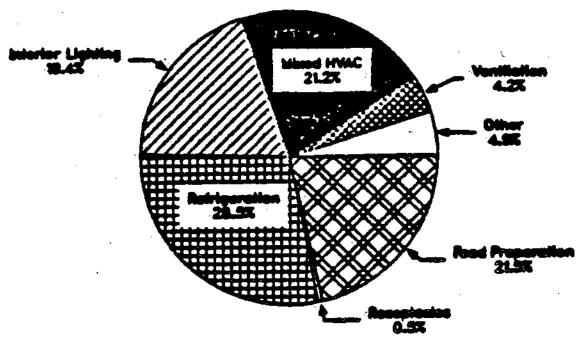
1. The interior lighting is a large part of the electric load. Much of the decorative lighting can be changed from incandescent to lower wattage fluorescents. The area manager is aware of compact fluorescents and will start making some changes in March or April 1988.

Cutting the interior wattage for lights would also decrease the demands on the air conditioning system in warm weather. It also might increase the heating load in the winter.

2. Food preparation and refrigeration are two large, year round loads. These need to be used as efficiently as possible. Do not turn on ovens before needed and turn off as soon as possible. Cook several things at the same time. Turn off some of the coffee warmers during slow times. Do not hold open refrigerators or freezers as often, and be sure to close doors promptly. This takes constant training of staff. The high turnover rate of employees makes this difficult.

SITE 593 7/ 1/87 to 7/31/87

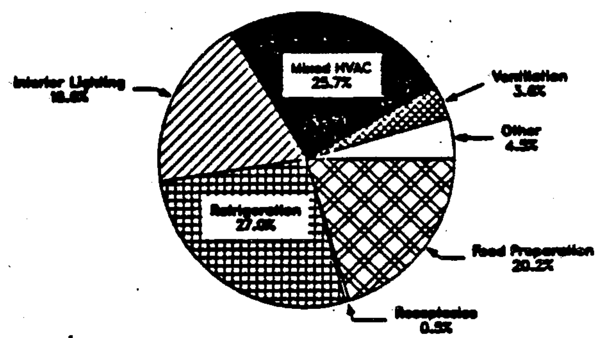
Share of Total Electricity Consumption 31,806 KWH
by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 593 8/ 1/87 to 8/31/87

Share of Total Electricity Consumption 33,807 KWH
by End-Use *



* Adjusted for percentage of good data
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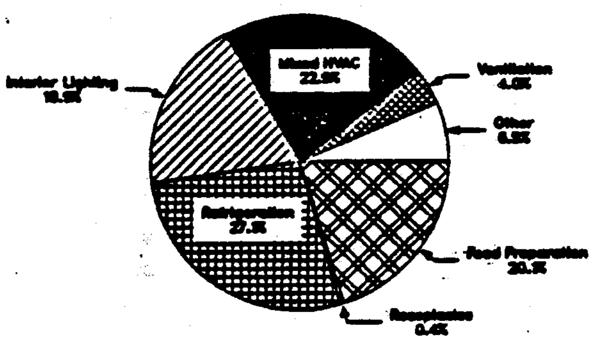
SITE 593 9/ 1/87 to 9/30/87

Share of Total Electricity Consumption 31,586 KWH
by End-Use *



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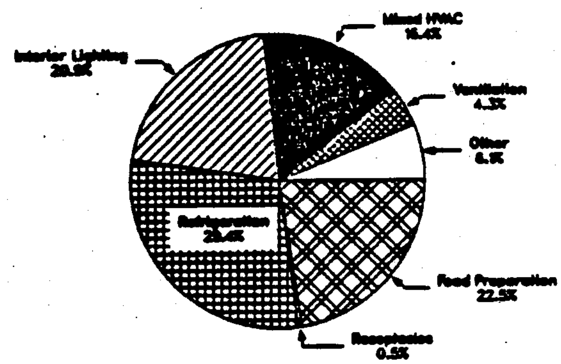
SITE 593 10/ 1/87 to 10/31/87

Share of Total Electricity Consumption 29,007 KWH
by End-Use *



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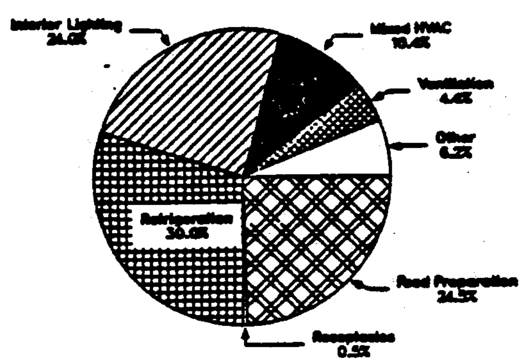
SITE 593 11/ 1/87 to 11/30/87

Share of Total Electricity Consumption 26,351 KWH
by End-Use *



* Adjusted for percentage of good data
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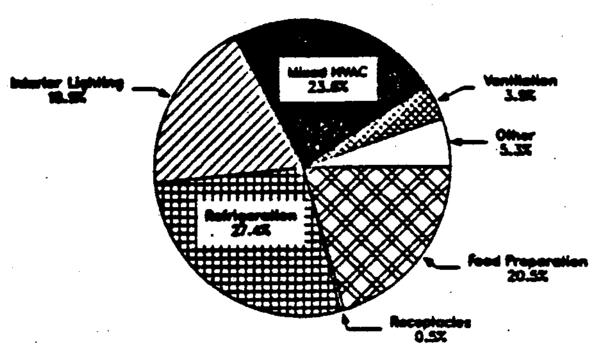
SITE 593 3rd Quarter 1987

Share of Total Electricity Consumption 97,467 KWH
by End-Use *



* Adjusted for percentage of good data
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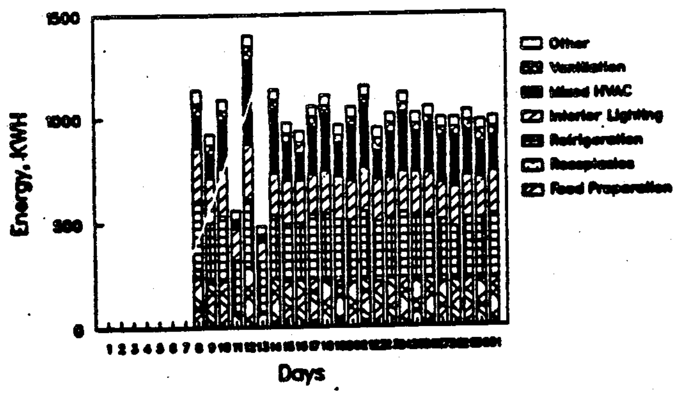
ELCAP

SITE 593 7/ 1/87 to 7/31/87

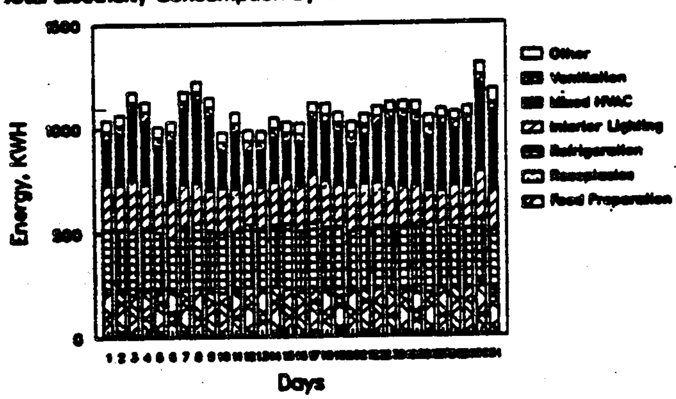
Total Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

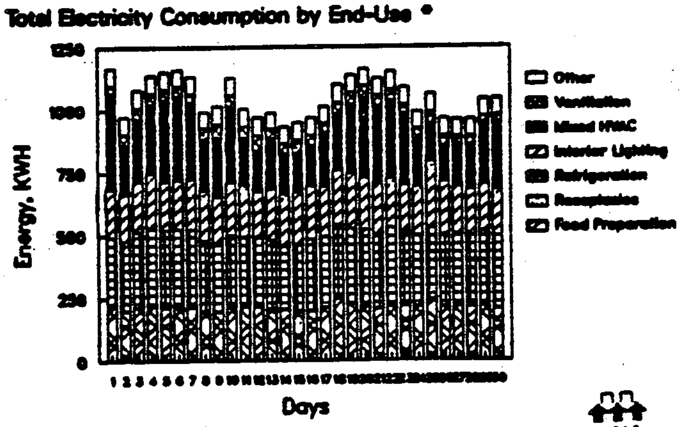
SITE 593 8/ 1/87 to 8/31/87

Total Electricity Consumption by End-Use *



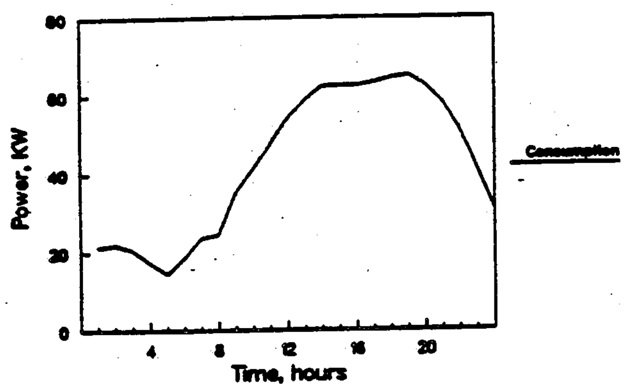
SITE 593 9/ 1/87 to 9/30/87

Total Electricity Consumption by End-Use *



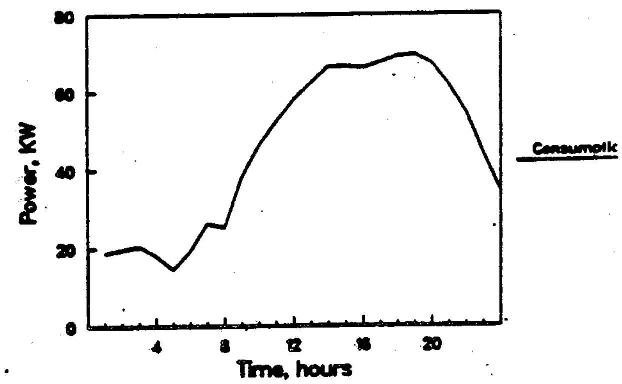
SITE 593 7/ 1/87 to 7/31/87

Average Daily Total Electricity Use



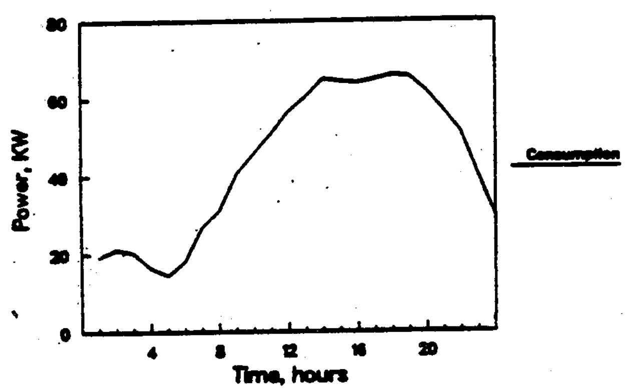
SITE 593 8/ 1/87 to 8/31/87

Average Daily Total Electricity Use



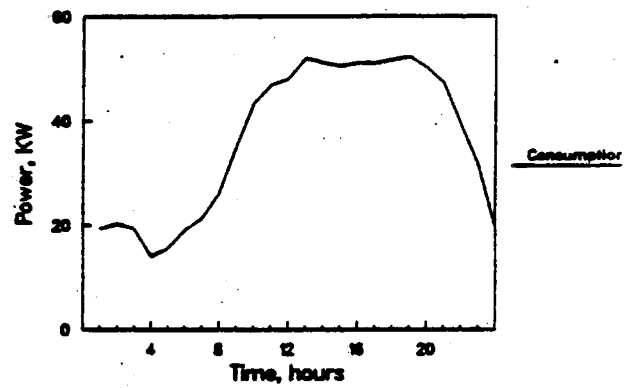
SITE 593 9/ 1/87 to 9/30/87

Average Daily Total Electricity Use



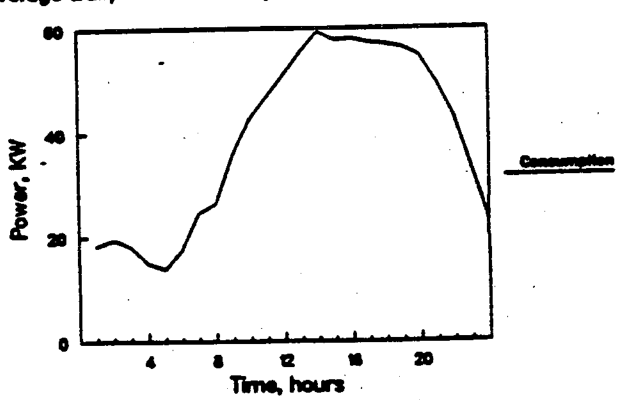
SITE 593 11/ 1/87 to 11/30/87

Average Daily Total Electricity Use



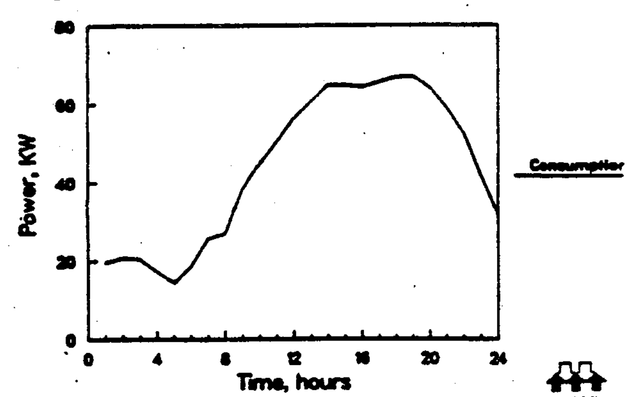
SITE 593 10/ 1/87 to 10/31/87

Average Daily Total Electricity Use



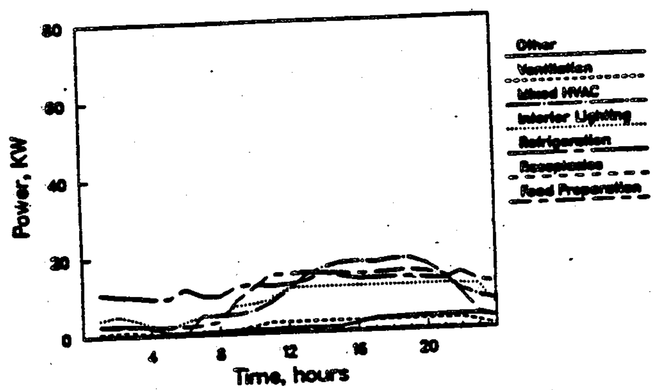
SITE 593 3rd Quarter 1987

Average Daily Total Electricity Use



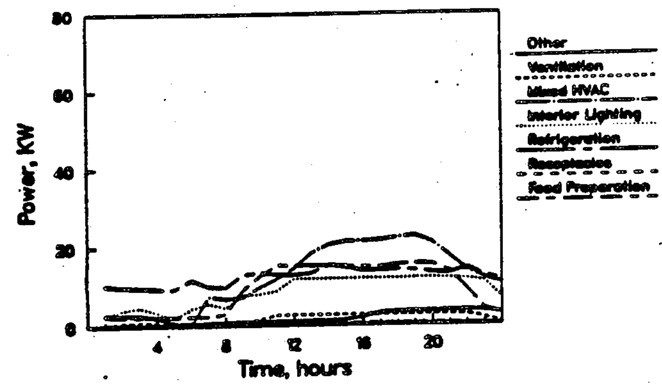
SITE 593 7/ 1/87 to 7/31/87

Average Daily Electricity End-Use Profile



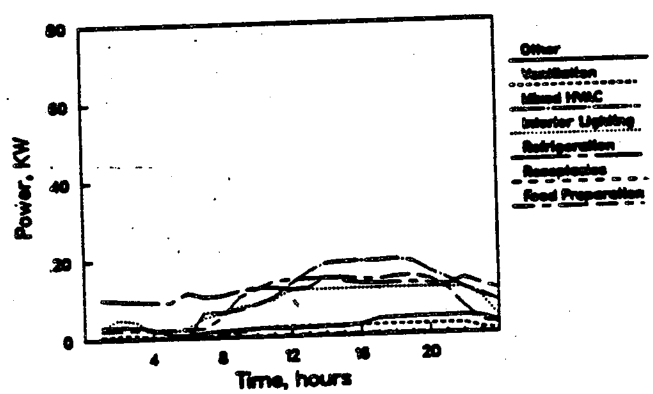
SITE 593 8/ 1/87 to 8/31/87

Average Daily Electricity End-Use Profile



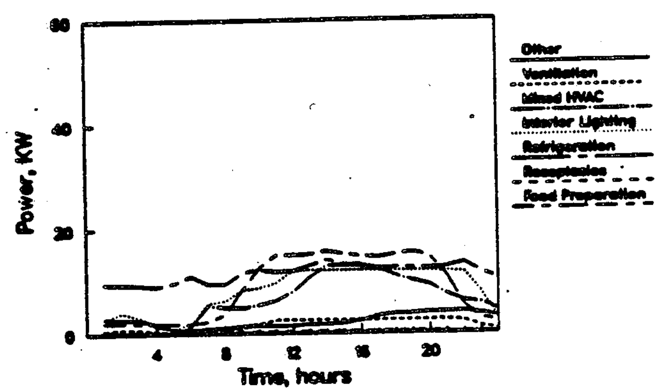
SITE 593 9/ 1/87 to 9/30/87

Average Daily Electricity End-Use Profile



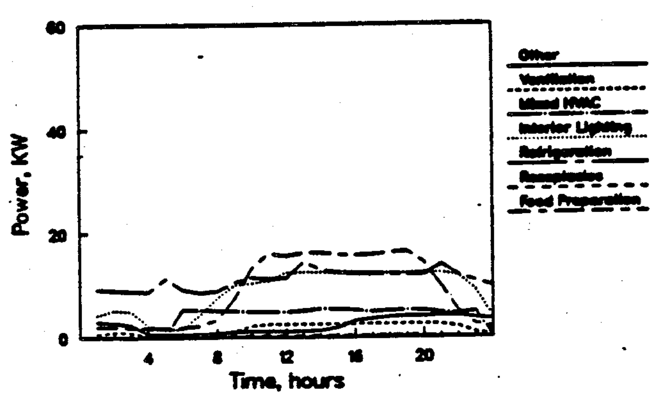
SITE 593 10/ 1/87 to 10/31/87

Average Daily Electricity End-Use Profile



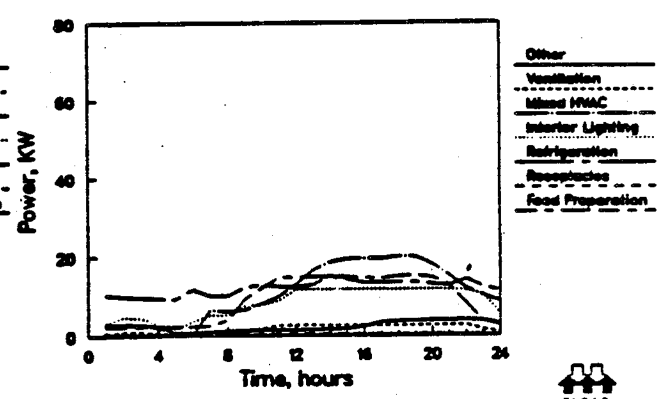
SITE 593 11/ 1/87 to 11/30/87

Average Daily Electricity End-Use Profile



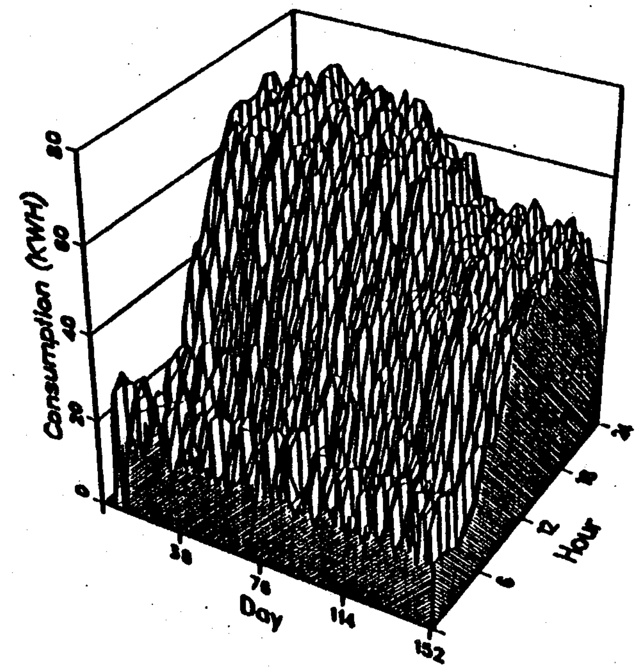
SITE 593 3rd Quarter 1987

Average Daily Electricity End-Use Profile



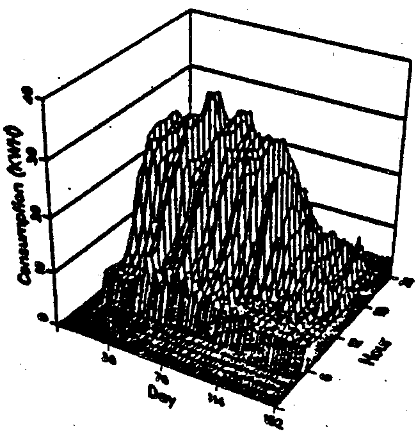
ELCAP

Site 593 July – November 1987



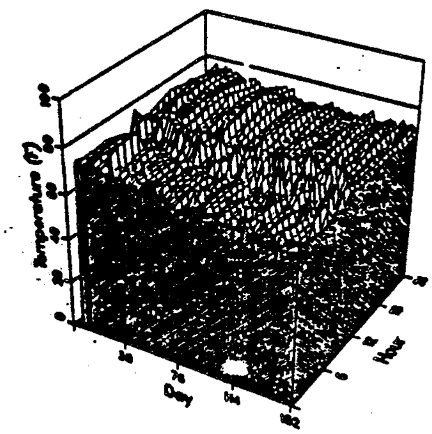
Building Total End-use
Restaurant Building

Site 593 July – November 1987



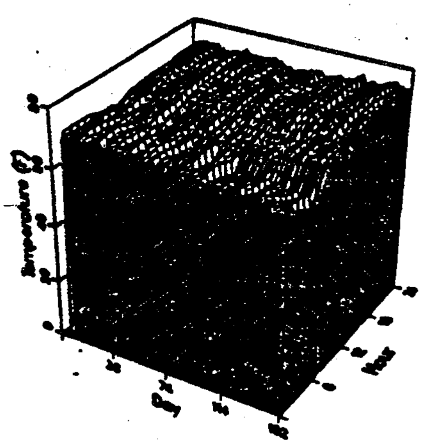
Mixed HVAC End–use
Restaurant Building

Site 593 July – November 1987



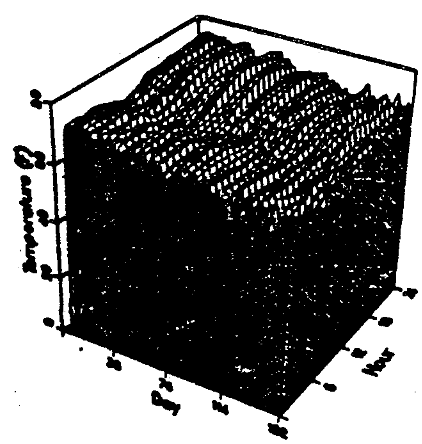
Interior Temp 1 End–use
Restaurant Building

Site 593 July – November 1987



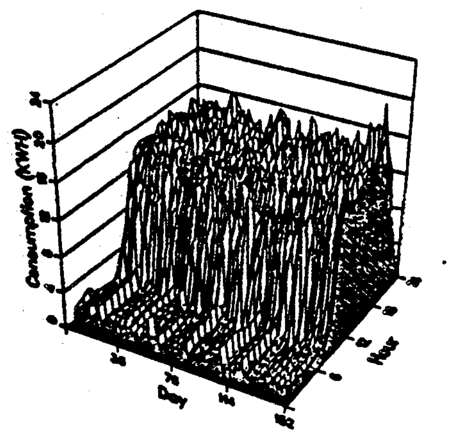
Interior Temp 3 End–use
Restaurant Building

Site 593 July – November 1987



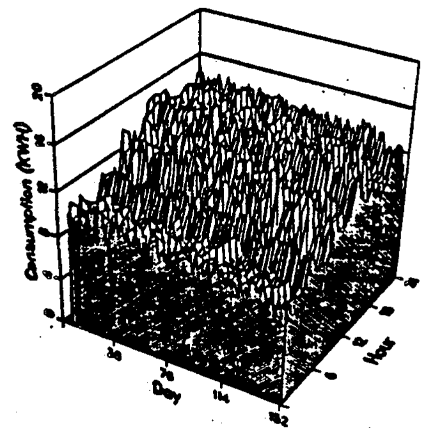
Interior Temp 2 End–use
Restaurant Building

Site 593 July – November 1987



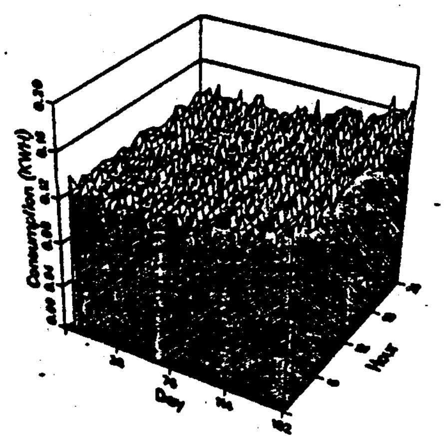
Food Preparation End-use
Restaurant Building

Site 593 July – November 1987



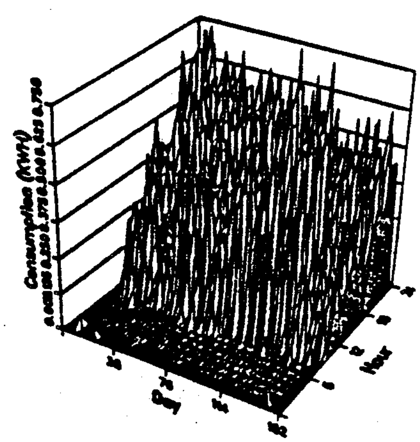
Refrigeration End-use
Restaurant Building

Site 593 July – November 1987



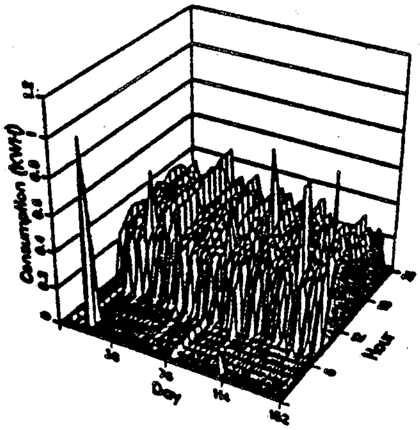
Water Heating End-use
Restaurant Building

Site 593 July – November 1987



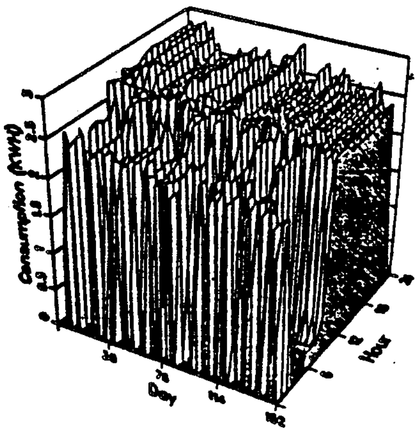
Sanitation End-use
Restaurant Building

Site 593 July – November 1987



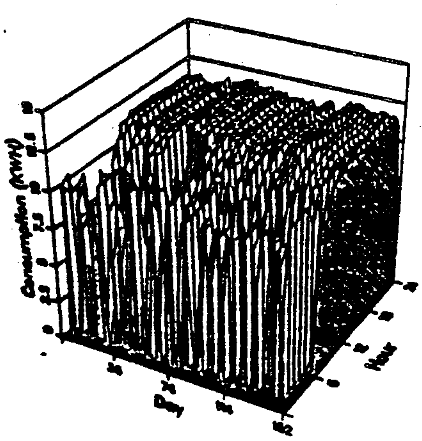
Receptacles End–use
Restaurant Building

Site 593 July – November 1987



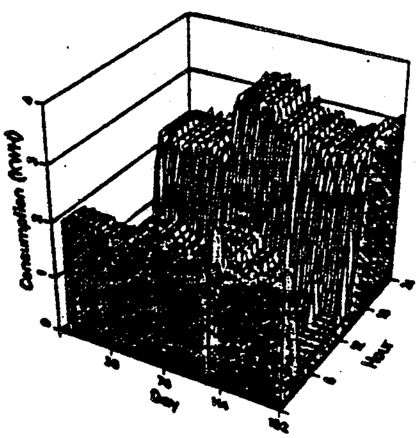
Ventilation End–use
Restaurant Building

Site 593 July – November 1987



Interior Lighting End–use
Restaurant Building

Site 593 July – November 1987



Exterior Lighting End–use
Restaurant Building

Bldg. ID RES402 | Year Built 1978

Primary Use Full service restaurant | Square Feet 8,554

Hours per week 103

Yearly Consumption - Electrical

1985 446,520 - 52.20 kwh/sq.ft.
1986 417,360 - 48.79 kwh/sq.ft.
1987 416,040 - 48.64 kwh/sq.ft.

Available Data

NONE

BLDG. CHARACTERISTICS

Floor	Slab on grade concrete
Walls	Wood, with R-19 insulation
Ceiling	Flat built up roof with R-11 insulation
Windows	No windows.
Sq. ft. windows	--

BLDG. SYSTEMS

Heating	Gas force air furnace
Air conditioning	Direct expansion Air conditioner
Hot water	gas water heater plus 2-40 gallon electric water heaters.
Refrigeration	Central compressor plus small loans.
Interior lights	240 w fluorescent 20,300 w Incandescent - 2.4 w/sq.ft.
Exterior lights	2,280 w Incandescent
Equipment I	Food prep equipment - all electric
Equipment II	Sanitation equipment

Bldg. ID SCH003 | Year Built 1970

Primary Use Elementary school | Square Feet 28,901

Hours per week 45 - from Aug 20 to July 1

Yearly Consumption - Electrical | Available endurance data

1985	234,540 - 8.12 kwhs/sq.ft.		NONE
1986	274,860 - 9.51 kwhs/sq.ft.	8.7 average	
1987	244,440 - 8.46 kwhs/sq.ft.		

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Face brick or wood, R5 insulation.
Ceiling	Flat roof with R13 insulation.
Windows	Clear double pane in aluminum frames.
Sq. ft. windows	1,256

BLDG. SYSTEMS

Heating	Forced air gas		
Air conditioning	None		
Hot water	Gas and electric heaters		
Refrigeration	Small		
Interior lights	Fluorescent	- 51,240 w	
	Incandescent	- 21,200 w	2.51 w/sq.ft.
Exterior lights	HID	- 5,900 w	
	Incandescent	- 3,145 w	
Equipment I	Audio visual equipment		
Equipment II	Office equipment		

SCH003, an elementary school located in an area of modest, well cared for homes, was built in 1970. It incorporated the "new" open classroom concept. It is a one story irregularly shaped building with a glass enclosed court yard and a few walls to create separate areas. There are enclosed offices for the principal, for the nurse and for the clerical staff. The custodians area, the kitchen and the teachers lounge are also enclosed rooms.

The exterior walls are mostly red brick. Some accent areas of wall have cedar siding. There is R5 insulation in these walls. About half the wall area has, at the top, a sloping 3 feet of aluminum siding with R13 insulation. The interior walls are finished with gypsum wall board. The flat roof has R13 insulation, a one foot air space and a gypsum wall board ceiling. The ceiling is nine feet high. The floor is concrete slab on grade, covered with carpeting and pad.

The 28,901 sq.ft. building has only 1,256 sq.ft. of windows, 294 sq.ft. can be opened and 962 sq.ft. are fixed windows. The center courtyard accounts for 546 sq.ft. of total window area.

Heat is provided by a central forced air system with four gas furnaces. There are also four air supply fans and ten exhaust fans. The custodian says the furnace never operates after 12 noon, even in the cold weather, as heat builds up in the building. The rest rooms have electric resistance baseboard heaters. There are two electric water heaters and a 50 gallon gas water heater with a circulating pump.

Interior lighting is primarily suspended ceiling fixtures with fluorescent tubes. In some areas these follow a pattern to outline a "classroom". Incandescent spot lights are also used to define hall areas and entry ways.

Exterior lights are controlled by photo cell. They are 3,145w of incandescent and 5,900w of HID lights.

OBSERVATIONS

On a 55° F morning in June the building was oppressively warm and humid, with a strong mildew oder. School was not in session and many of the lights were turned off. The door to the courtyard was open and a large fan was being used to draw in air. According to the principal, who had the one window in her office wide open, people come to her office to cool off and get some air. The biggest complaint about the building is that it is hot and stuffy.

The building was designed as an open classroom concept and has some distinctive architectural features, such as the rough cedar walls in some of the inner spaces, peeled log columns to divide areas, and low ceilings to baffle noise. Dark yellow and orange wall colors, and very few windows create a dark and confining feeling.

The open library area has a 12 ft. ceiling and faces one side of the courtyard giving it a lighter atmosphere.

The building was designed for about 400 students but by 1987 was serving over 500. Two portable classrooms were connected to the separate gymnasium's electric load and the one large office in the main building is being used as a classroom. The gym and portables are not included in the ELCAP monitoring. Since all the students use the main building's common areas the load is greater than originally designed.

The difference in the calendar year electric consumption can be explained by a lengthy teachers' strike in the fall of 1985 which kept the schools closed until October 1. In the summer of 1986 school continued until July 4 to make up for the time lost the previous fall.

RECOMMENDATIONS

- The greatest opportunity for electrical savings in this building is in changing the lighting. Levels could be improved and considerable savings obtained with new efficient fixtures with efficient ballasts, tubes and with reflectors. The spot lights could be replaced with fluorescent spot lights. There would also be less heat generated by these efficient fixtures. Exterior lights could be changed to high pressure sodium for more savings.

- Lighter colors inside the building would also improve the lighting levels.

- There is something wrong with the operation of the ventilation system. The system installed should be capable of a complete air change every ten minutes. Correcting the operation and balancing the system would probably result in using more gas for heating and more electricity for supply and exhaust fans. However, the improved air quality and preservation of the building would be well worth it.

Bldg. ID	SCH 004	Year Built	1955
Primary Use	Day Care	Square Feet	3614
Hours per week	48		

Yearly Consumption - Electrical - SCL Billing

Available End Use Data

1985 - 32,838 - 9.0 kwhs/sq.ft./yr.
1986 - 27,379 - 7.6 kwhs/sq.ft./yr.
1987 - 25,735 - 7.1 kwhs/sq.ft./yr.

BLDG. CHARACTERISTICS

Floor	Basement or concrete slab on grade
Walls	Wood frame, R-11 or concrete block
Ceiling	Attic, R-19 or flat roof, R-19
Windows	Single pane
Sq. ft. windows	147 sq.ft. in aluminum frame 284 sq.ft. in wood frame

BLDG. SYSTEMS

Heating	Forced air, oil and 2 portable electric baseboard heaters
Air conditioning	0
Hot water	80 gallon electric
Refrigeration	Residential size
Interior lights	1040 w fluorescent 1680 w incandescent - 0.8 w/sq.ft.
Exterior lights	180 w incandescent
Equipment I	Food prep
Equipment II	

SCH 004 is a private day care center operated at this location by the same owner for 20 years. The building was originally a 1382 sq. ft. house with a 1332 sq. ft. basement built in 1955. The date of the one-story (900 sq. ft.) basement extension at the back is uncertain. The day care center is located at a tight intersection of three arterials in a mixed commercial-residential area.

The front yard of the house has been covered with asphalt and enclosed by a three-foot high cyclone fence to provide a play area where the small clients can ride their toys and play on larger equipment. The backyard is also fenced, but covered with wood chips which give a softer play area.

A home-like atmosphere is maintained in the reception/living room/TV room. Reception desk and office space is just inside the door. A hallway is to the right. The kitchen and former bedrooms--now "classrooms" and dining room-- are off the hall. An open stairway next to the hall leads to the lower level where there are more "classroom" and furnace, water heater and electrical rooms. The backyard is reached by a door on the north side and the front yard, by one on the east.

The original house is woodframe with R-11 wall insulation and R-19 ceiling insulation. The addition, which extends out back from the basement is on a concrete slab on grade with uninsulated concrete block walls, most of which are covered with wood siding to match the house. The flat, built up roof of this section has R-19 insulation. The below grade basement walls of the main house are furred out and finished with wall board, but are uninsulated.

There are 147 sq. ft. of single pane aluminum frame windows, most of which are on the west side of the addition. Two hundred forty-eight sq. ft. of single pane wood frame windows are in the original structure. Unlike most homes, this building has five exterior doors, all wood or wood and single pane glass.

Heat is supplied by a forced air, oil furnace. Two plug-in electric baseboards can be used to supplement the furnace. Exhaust fans in the restroom, kitchen and dining room help control the heat and humidity. Windows also can be opened.

Interior lights in the classroom are fluorescent. The exit lights, hallway, restroom, dining room, entry way lights and some table lamps have incandescent bulbs. Code requires hall lights to be on 24 hours a day. Other lights are turned on as needed then turned off. Exterior lighting is minimal, two 60-W incandescent bulbs at the front door and one at the back.

Domestic hot water comes from an 80 gal. electric water heater which is kept at 140° F. A mixing valve at the tank adds cold water to the lines going to the restrooms so it is 120° F at these faucets. A new super insulated tank was installed after January 1987. A new electric kitchen stove with self cleaning oven was also installed at that time.

The center operates from 6:30 a.m. to 6 p.m. five days a week. It is closed on major holidays and is open for few children on "semi" holidays, like the Friday before a Saturday holiday. The facility is licensed for 52 children and averages about 48 at any one time. Usually there are about six employees--eight at busy times.

The facility is a low commercial consumer of electric power, using 26,190 kWh during the past year and 29,656 kWh the year before. The major heating load is taken care of by the oil furnace. There is no air conditioning.

Data:

We have reliable end-use data for one month, September 1986. Graphs #1 and #5 show the major consumers are interior light (31 percent) and water heating (30 percent).

The week days show higher consumption than weekends and holidays when the center is closed, graph #2. Water heating, food preparation and general mixed loads show the greatest variations. The mixed load includes outlets, electric heaters, aquarium, fans and TV.

Graph #2 shows daily use and #3 illustrates the average hourly end uses. The food preparation, water heating and mixed loads show very definite time of day spikes reflecting the activities of the day care center. The arrival of staff raises the general mixed and interior light consumption. As the children arrive the general mixed rises some more. The water heating shows a dramatic change and continues to rise before lunch. It drops at lunch then peaks after lunch due to clean up. There is another water heating spike at closing which is also a clean up time. Food preparation shows a noticeable rise just before lunch time.

Graph #4 shows a weekly increase in loads as the month progresses. This reflects the increasing enrollment as the regular school year begins, summer baby sitters return to school and families are back from vacation.

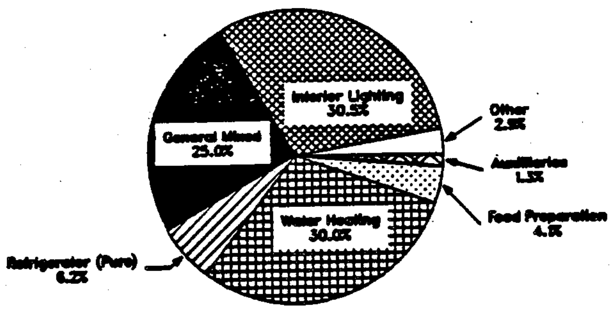
With data for subsequent months, an increase would be expected for the entire building. The water heater and the auxiliaries for the oil furnace are temperature sensitive. Interior lighting would be used more as daylight hours shorten. Mixed load should increase, especially with the electric heaters plugged in, as there is more indoor activity. Summer should then return to the pattern shown the first part of September.

Recommendations:

The interior incandescent lighting could all be changed to fluorescent, a relatively inexpensive measure. This would be particularly important with the hall lights and exit lights which are on 24 hours a day. As can be seen from graph #1 and graph #5, interior lighting is a significant load.

SITE 558 9/ 1/86 to 9/30/86

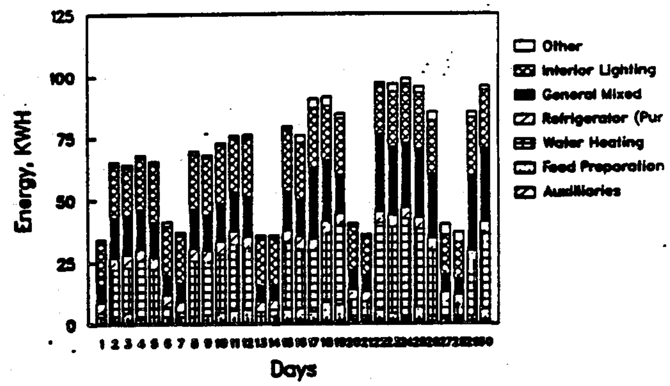
Share of Total Electricity Consumption 2,043 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

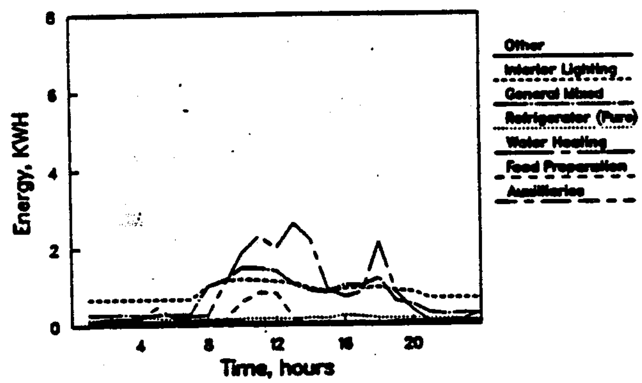
SITE 558 9/ 1/86 to 9/30/86

Total Electricity Consumption by End-Use *



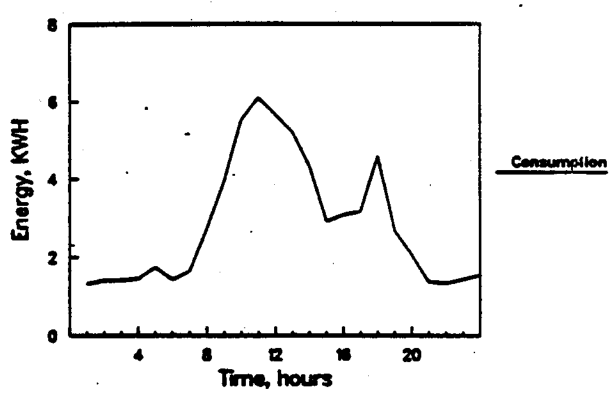
SITE 558 9/ 1/86 to 9/30/86

Average Daily Electricity End-Use Profile



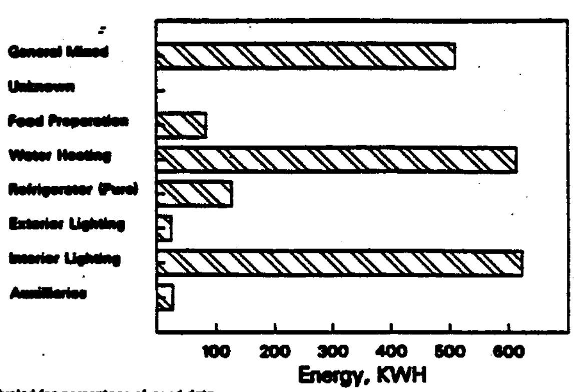
SITE 558 9/ 1/86 to 9/30/86

Average Daily Total Electricity Use



SITE 558 9/ 1/86 to 9/30/86

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID SCH101 Year Built 1907

Primary Use Elementary School & Daycare Square Feet 52,911

Hours per week approx. 65 - school year months only

Yearly Consumption - Electrical - SCL Billing

		Available End Use Data
1985	147,028 - 2.8 kwh/sq.ft. per year	NONE
1986	171,197 - 3.2 "	
1987	167,025 - 3.2 "	

BLDG. CHARACTERISTICS

Floor	Concrete basement
Walls	Old part frame - no insulation, New part brick - no insulation.
Ceiling	Concrete - no insulation, both parts.
Windows	Clear, single pane in wood frames.
Sq. ft. windows	6,476 sq.ft.

BLDG. SYSTEMS

Heating	Was oil, converted to gas in 1987 - steam boiler
Air conditioning	--
Hot water	80 gallon, gas with circulating pump, one electric water heater.
Refrigeration	Moderate load in cafeteria.
Interior lights	23,275w fluorescent 30,535w incandescent - 1.02w/sq.ft.
Exterior lights	1,550w incandescent
Equipment I	Audio visual equipment
Equipment II	Kitchen equipment

SCH101, an elementary school is two stories with a basement. The original frame building was built in 1907. The "new" brick portion was built in 1917. It is a focal point in an older neighborhood and is used for many activities other than just school. The two buildings total 52,911 sq.ft. and have 13 ft. ceilings on all three floors. The hallways are 14 to 16 ft. wide providing a lot of open spaces. The original building has concrete basement walls. The upper floors have wood siding with four inch framed walls, finished on the inside with lath and plaster. The "new" section is 12 inch brick masonary walls finished with lath and plaster on the inside. The ceilings in both buildings are concrete slabs with air space above and either slate or asphalt shingled roof. There is no insulation in the buildings. The "new" building has 325 sq.ft. of single pane skylights.

A 882 sq.ft. room is part of the basement between the two buildings, with no floors above it. The roof in that area is concrete with flat built up roof. It also has two 96 sq.ft. skylights. All of the windows are single pane in wood frames. Most are 5 ft. by 9 ft. or 4 ft. by 7 ft., providing abundant daylight to the rooms.

The central steam heat was generated by an oil burner at the time of the original survey. In 1987 the system was converted to gas. There are fans to supply air in some parts of the system but not all of it. There are assorted electric resistance baseboard heaters but they are seldom plugged in or turned on.

Many of the classroom lights were changed to suspended fluorescent ceiling fixtures years ago. But there are still a number of incandescent lights for interior lighting. Exterior lightings is all incandescent.

OBSERVATIONS

While the heating bills for this drafty old building are probably high and there is a lot of "wasted" space in the wide halls, the large central areas and the big windows all create a bright and airy atmosphere. This is in sharp contrast to the more modern school in the sample (SCH003).

The custodian feels the switch to gas heat was good; that it delivers quicker heat and is cleaner than the oil heat.

While the building shows its age, it has been well maintained and continues to be an important part of the public school system and of the community.

It is used for numerous community groups as well as extra circular activities at least two nights a week. Day care for students is provided during the school year from 7 am to 9:10 am and from 11:45 am to 6 pm.

It is seldom used on the weekends as any groups using it would have to pay an extra fee for a custodian to work weekends.

RECOMMENDATIONS

- Some of the large windows in the hall have been covered with sheets of heavy acrylic, primarily to prevent breakage but in the process also provide insulation to these windows. This strategy would not be recommended for the rest of the windows as they must be opened for fresh air supply. The newer section does have some mechanical ventilation but does not meet the full need in hot weather.

- The exterior lighting and some of the interior lighting such as stairwells and hallways could be changed to high pressure sodium for considerable savings.

- It is unusual today to have a building like this with higher wattage for incandescent lights than for fluorescent. The 30,535 watts of incandescent could be changed to lower wattage efficient fluorescent fixtures which would provide better light and require far fewer lamp changes as they burn 10,000 to 12,000 hours vs. 1000 to 2000 hours for the incandescents now in place. Many are in difficult to reach areas. The work hours saved by fewer changes would be significant.

- The attics in both buildings could have insulation blown in, a relatively inexpensive measure which should save a considerable about of heat in the winter. Since the building is not used much in the summer the improved comfort level would not be appreciated as much but, it would be there.

- Better exterior doors would cut down on the infiltration. The present swinging doors have large gaps around them.

Bldg. ID UNI001 Year Built 1945

Primary Use Student activities Square Feet 27,183

Hours per week 55 hours when school is in session

Yearly Consumption - Electrical - SCL Billing | Available End Use Data

1985	147,960 - 5.44 kwhs/sq.ft.		NONE
1986	154,440 - 5.68 kwhs/sq.ft.	5.82 average	
1987	172,260 - 6.34 kwhs/sq.ft.		

BLDG. CHARACTERISTICS

Floor	Concrete basement, ½ below and ½ above grade.
Walls	Concrete
Ceiling	Flat built up roof, R10 insulation.
Windows	Double pane in metal frames. Single pane in wood frames.
Sq. ft. windows	413 sq.ft. double 336 sq.ft. single

BLDG. SYSTEMS

Heating	Hydronic, oil fired boiler, several portable electric heaters.
Air conditioning	Chiller with constant volume air handling system.
Hot water	Gas water heater
Refrigeration	--
Interior lights	37,638w fluorescent 5,147w incandescent - .86w/sq.ft.
Exterior lights	400w incandescent 150w High pressure sodium
Equipment I	Office equipment
Equipment II	--

UNI001 was originally a retail store built in 1945. It has a 12 foot high daylight basement facing the alley. On the street level there is a 10 foot high ceilinged retail space. In 1967 the neighborhood was changing. A large community college was growing up around the store. The store was bought by the college and transformed into an office-activity building. At the back, a second floor was added to provide an additional 4,709 sq.ft. The main floor is an open space with restrooms located in the center. The elevator and another small room toward the back also help divide the space. On the back wall are a conference room and a kitchen. The other walls have temporary panelling put up to form small offices around the perimeter. The open areas have desks or tables to define different student activity programs. Upstairs are more restrooms and two large open spaces for arts and crafts.

The basement houses the mechanical rooms, boiler room, telephone room, a small office and a classroom.

The building occupancy varies each quarter, depending on student interest. The appearance is very casual and temporary, (even though it has been used "as is" for over 20 years), and a little run down. One of the restrooms is not working, cracked or chipped windows are not replace, things are not repainted. The college hopes to receive funding to demolish this building within the next few years. A vacant lot, used for parking is on the south side and another store front building beyond that is the college bookstore. The plan is to build a large, more functional building on these three sites.

The structure is basic reinforced concrete with gypsum wall board on the inside. The flat built up roof was replaced in 1985 and R10 insulation was added.

The 413 sq.ft. of double pane windows in metal frames are at the back, on the east side of the building. The 336 sq.ft. of single pane windows in wood frames are on the west side, the original store front construction.

When it comes to central systems this building has a mixture. It has an oil fired boiler for hot water heat. Several people have also brought in portable electric resistance heaters. Air conditioning is provided by a central chiller and constant volume air handling system. Domestic hot water is heated by gas.

The interior lighting is mostly four foot fluorescent ceiling lights. Exterior lighting is incandescent and high pressure sodium on a photo cell which was not working.

Since this building is scheduled to be demolished no energy conservation measures are recommended. When the new building is approved and built it will offer a great opportunity to incorporate all of the new energy saving technologies.

Bldg. ID UNI004 | Year Built 1976

Primary Use Community College | Square Feet 74,271

Hours per week 70

Yearly Consumption - Electrical | Available End Use Date

1985) Do not have SCL
1986) > billing data for
1987) individual buildings.

NONE

BLDG. CHARACTERISTICS

Floors	Concrete slab on grade, R-5.3 insulation.
Walls	Precast concrete, R-11 insulation.
Ceiling	Flat built up roof, R-8 insulation.
Windows	Clear, single pane in metal frames.
Sq. ft. windows	5,558
Sq. ft doors	1,296

BLDG. SYSTEMS

Heating	VAV supply to CV reheat boxes with electric resistance. Electric resistance base board and unit heaters.
Air conditioning	VAV rooftop to central system.
Hot water	Two electric, 250 gallons with circulating pumps.
Refrigeration	--
Interior lights	148,438 w - fluorescent 29,090 w - incandescent - 2.39 w/sq.ft
Exterior lights	1,200 w - incandescent 18,350 w - HID
Equipment I	Office equipment and computers.
Equipment II	Kilns, photography, audio visual etc.

UNI004 is four buildings of a community college arranged around a quadrangle. There are a total of 74,271 sq.ft of heated space in the attractive, one story, low profile, precast concrete buildings. It was built in 1976 and houses the library, bookstore, art and TV studio & class rooms, as well as large common areas, administration and other offices. As part of a very busy community college, the buildings are open from 8 am to 5:30 pm for day classes and from 5:30 pm to 10 pm for evening classes, 5 days a week, most of the year, except for holidays or short breaks between quarters.

The walls are insulated with three inch batt insulation. The plenum walls, above the dropped ceiling, have two inches of rigid insulation. Above this 21 inch high plenum there is a 2 ft. truss in place. Above this is three inches of rigid insulation under the flat roof deck. The concrete slab floor is insulated with two inches of rigid foam. The windows and glass doors are all single pane, clear glass.

The HVAC system is a sophisticated central system with roof top air conditioners with variable air volume which supplies air to some constant volume reheat boxes with electric resistance coils and to some VAV boxes with no reheat. The Honeywell EMS has an economizer cycle and the system is controlled by enthalpy. Electric baseboard heaters are located on the outside walls and cabinet heaters in the corridor and lobby. These are controlled by thermostats with night set backs.

Most of the lights are fluorescent ceiling fixtures but there are a few incandescent lights in meeting rooms, photography studio and for stage lights. The exterior lights are HID soffit lights, pole lights and low walkway lights. The building has a high equipment load as there are many computers, typewriters, copiers, audio equipment, a video studio, photography dark rooms and other electric equipment; (for example, welder, drill press, pottery wheels, kilns) associated with the library, art studios and audio-visual studios. There are also many coffee pots in the offices. The impression is that there are high internal heat gains.

AUDITOR'S OBSERVATIONS

In 1988 the campus began participation in the commercial retrofit program through SCL. Measures recommended by the consultant were: A campus wide automation system and variable speed drives. These measures will probably be installed the second or third quarter of 1989. The campus automation system would provide the following features not present in the existing system; optimum start for some buildings, automated instead of manual holiday scheduling, zone scheduling, alarm reporting, remote monitoring and an increased number of control points. The variable speed drives would control motor speed and therefore duct pressure for the supply fans.

Since this building's energy use was simulated by the consultant it will be very interesting to have the data from PNL to compare. The consultant determined from the simulation that it would not be cost effective to install double glazing, more roof insulation, lighting controls, duty cycling of HVAC equipment, domestic hot water heat pump or more perimeter slab insulation. It was unacceptable to the institution to reduce exterior lighting levels, to reduce outside air, decrease use of computer equipment, or to install insulated window coverings.

Operation and maintenance measures continue to be important and the most cost effective way to save energy.

Bldg. ID WAR002 Year Built 1969

Primary Use Warehouse Square Feet 12,587

Hours per week 59.5

Yearly Consumption - Electrical - SCL Billing Available End Use Data

1985	Puget Power customer	March 1987
1986		
1987		

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Concrete
Ceiling	8,087 sq. ft. flat roof, no insulation 4,500 sq. ft., flat roof, R-20 insulation
Windows	None
Sq. ft. windows	0

BLDG. SYSTEMS

Heating	Forced air gas and electric resistance baseboards
Air conditioning	None
Hot water	None
Refrigeration	Small
Interior lights	5040 w fluorescent 75 w incandescent - 0.4 w/sq.ft.
Exterior lights	360 w incandescent
Equipment I	Hoist and other equipment
Equipment II	Battery chargers

WAR002 was originally a 8,087 sq. ft. furniture warehouse built in 1969, occupied by the present business in 1981 and enlarged by an additional 4,500 sq. ft. in 1986. It is connected to a smaller, one-story building which most recently was used as a day care center. The wall between the two warehouse spaces has been removed, creating one conditioning zone for both areas. It is open from 9 a.m. to 5:30 p.m. Monday through Thursday and Saturday, 9 a.m. to 9 p.m. Friday, and 12 noon to 5 p.m. on Sunday.

Inside the original warehouse is a 672 sq. ft. office-workshop, closed off by a ceiling, walls, windows and a closed door from the rest of the warehouse. This space is heated by electric baseboard resistance heaters. Usually this is the only warm place in the building during the winter. The warehouse space has three gas forced air units at the ceiling. These are turned off at the circuit breaker unless it is so cold the sprinkler system pipes are in danger of freezing. One of the large doors is kept open most of the year during business hours, except when it is extremely cold outside.

When the new addition was added the interior lights in the older section were upgraded. This upgrade was included in the original survey. Employees say it was dark before, now it is very well lit. Customers come to the warehouse frequently to pick up furniture orders. Appearance and light are important factors.

Interior lighting is ceiling hung fluorescent, 8 ft., 2 light fixtures. Exterior lighting is an incandescent 300-Watt over one freight door and one incandescent 60-Watt over one man door.

Crates, boxes, individual pieces of furniture and stacks of wrapped mattresses are neatly arranged in wide rows, leaving enough room to maneuver the large items in the aisles.

The walls are all plain concrete except in the restroom, which is actually a part of the one-story day care building connected to sixty feet of the west side of the building. That is the only one wall framed out and finished with drywall.

The 4500 sq. ft. addition has R-20 batt insulation in the ceiling. The original area has only foil and vinyl stretched below the decking. The floor is slab on grade, uninsulated concrete. There are two 12x12 ft. freight doors, one 18x15 ft. and two man doors. There are no windows.

Data:

With just one month's data (March 1987) and no discrimination of the "other" load, which accounts for 52 percent of the total consumption, it is difficult to draw many conclusions from the data. The ½ HP hoist, the sander, grinder and other electric tools as well as the refrigerator, battery chargers and office equipment are all included in "other," see graph #1.

The exhaust fans and fans for the forced air gas heaters are included on mixed HVAC. The electric baseboards in the office-workshop section are coded as heat.

On graph #2 we see the lights on longer on Fridays when they are open late and on less on Sundays when they are open fewer hours. There is no explanation for the increase in HVAC on the 24th and the disappearance of "other."

It would be more useful to have the gas heat auxiliaries separated and the shop equipment totals separated. Also, data for more than one month will give a better picture of the total operation of the building.

Auditor's Observations and Recommendations:

1. The outdoor lighting could be reduced significantly by using 50-Watt HP sodium instead of the 300-Watt incandescent and a HP sodium or a low wattage fluorescent instead of the 60-Watt incandescent.

2. Efficient ballasts and lower wattage fluorescent fixtures could replace the present overhead lights. The interior fluorescent overhead lights can be controlled by area and some could be turned off when that area is not being used or customers are not coming into the building. Motion sensors would automatically do this.

3. Shell improvements for the entire building are not recommended as it is used as a warehouse and heated only the occasional times our mild climate produces freezing temperatures. The enclosed office which is heated much of the year could have insulated batts laid on its roof, as temperature in the warehouse is usually almost as low as outdoor temperatures, typically 40°-50°F, in the heating season.

4. The day care facility next door has been closed since fall 1986. This part of the facility is not being monitored in the ELCAP study. However the restroom connected to the warehouse is actually part of the day care facility. The incandescent lights are on the day care circuit. Two 13-watt fluorescents could be exchanged for the two 60-watt and two 40-watt (usually one or two are burned out) as the lights are left on during the day.

Even if the day care were operating and heated all day, it would have little effect on the warehouse. Only 660 sq. ft., out of a total of 9,900 sq. ft. of wall area are contiguous, allowing for heat transfer.

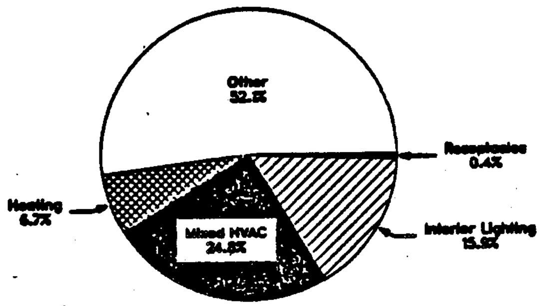
5. Payback for any conservation measures would be shorter for this building than for a building in the SCL area because it is located in Puget Power Service Area. Their rates are higher than SCL rates.

Puget Power Commercial Rates - 1987*			SCL		1987*
	Summer	Winter		Summer	Winter
1st 2000 kwhs	.0447	.0470	Small coml.	.0256	.0421
all over 2000 kwhs	.0350	.0368	Med. coml.	.0211	.0352

*Demand charges may also be levied.

SITE 736 3/ 1/87 to 3/31/87

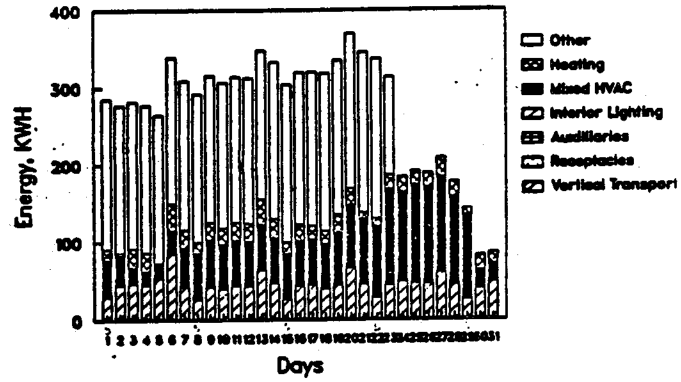
Share of Total Electricity Consumption 8,446 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

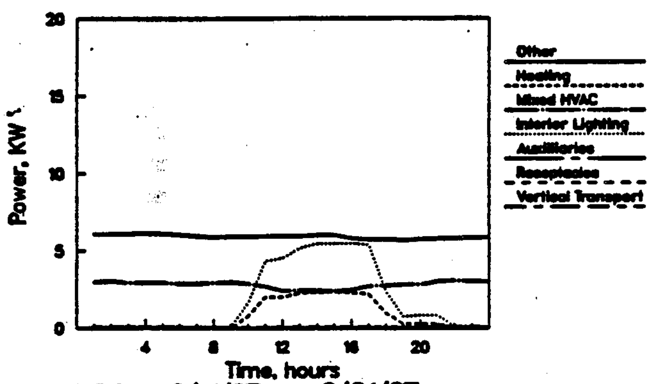
SITE 736 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



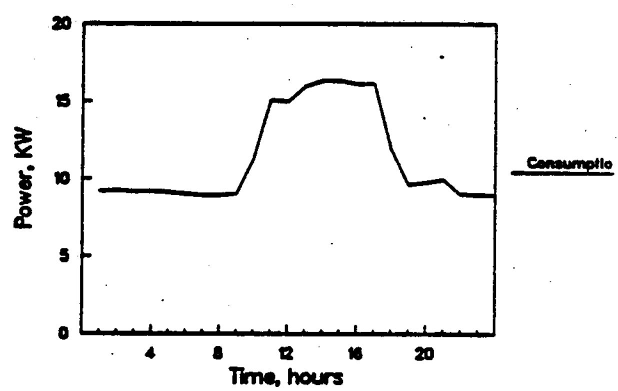
SITE 736 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



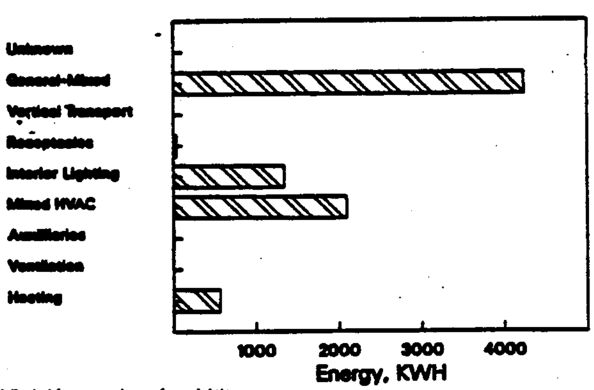
SITE 736 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 736 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

Bldg. ID WAR003 Year Built 1930's remodeled 1977

Primary Use Mixed use - Warehouse Square Feet 10,772

Hours per week 80

Yearly Consumption - Electrical

Available Data: NONE

1985 >
1986 > history is unclear
1987 >

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Concrete or wood, no insulation.
Ceiling	Flat, built up roof, no insulation.
Windows	Single pane in, metal frames.
Sq. ft. windows	521
Doors	Metal roll-up
Sq. ft. doors	584

BLDG. SYSTEMS

Heating	has unit heaters in warehouse, electric baseboard, plug in heater and electric furnace in offices.
Air conditioning	Portable air conditioner
Hot water	Electric water heater
Refrigeration	Small
Interior lights	10,364 w fluorescent 2,315 w incandescent - 1.18 w/sq.ft.
Exterior lights	650 w incandescent 600 w Halogen on photo cell
Equipment I	Welder, grinder, drill press, battery charger, etc.
Equipment II	Office equipment

Bldg. ID WAR005	Year Built 1977
Primary Use Warehouse	Square Feet 10,950
Hours per week 45	

Yearly Consumption - Electrical

1985 217,620 = 19.9 kwhs/sq.ft.
1986 214,020 = 19.5 kwhs/sq.ft.
1987 224,820 = 20.5 kwhs/sq.ft.

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Six inch concrete, no insulation
Ceiling	Flat built up roof, R-6 insulation
Windows	Single pane, metal frames
Sq. ft. windows	76
Sq. ft doors	290

BLDG. SYSTEMS

Heating	Electric resistance with constant volume, single duct system. Electric baseboard in office.
Air conditioning	Direct expansion
Hot water	Electric
Refrigeration	--
Interior lights	Fluorescent - 16,240 watts incandescent - 1,350 watts 1.6 w/sq.ft.
Exterior lights	Incandescent
Equipment I	Saws & other shop equipment.
Equipment II	--

WAR005 is a 10,950 sq.ft. warehouse built in 1977. It is a busy place dealing in wholesale hardware. In the small office area four or five employees are processing orders and working with customers. The warehouse section seems crowded and noisy with all of the activity going on there. In fact the business will add a 6200 sq.ft. addition at the end of 1988 to help meet the demand for service.

The present building's walls are six inch concrete, no insulation. The floor is slab on grade and the flat roof has two inches of rigid insulation. The 60 sq.ft. of window and the office door, which face west, are single pane glass with reflective film. There are 16 sq.ft. of clear glass office windows on the north side. The doors to the warehouse are a front and a side man door and two large, over head, metal roll up doors. These doors are often left open during business hours.

The entire building is conditioned by a single duct, constant volume system with resistance duct heaters and direct expansion air conditioner. There is also an electric baseboard heater in the office. Nine ceiling fans are used to destratify the air in the warehouse. Hot water is heated electrically. The new addition, which will be open to the present building will be gas heated.

Lights are 16,240 watts fluorescent ceiling light fixtures and 1350 watts of incandescent display lights. Exterior lights are incandescent canopy lights. Equipment in the warehouse are saws and presses used in customizing the kitchen cabinets before they are sent out.

AUDITOR'S OBSERVATIONS

The building has air conditioning but it is not used very often. There is a night set back for the heat. The exterior lights do not have a time clock or photocell.

Care should be taken that this building is not being heated when the large doors are open. Because the office has baseboard heat it is possible to turn off the heat in the warehouse where the very active workers do not require heat except when it is very cold.

The demand for domestic hot water is not great. A small, at the source water heater could meet the demand, and eleminate the stand by loss of the present water heater.

Exterior lighting could be changed to fluorescent or high pressure sodium and a time clock or photocell installed. This would eleminate the chance of people forgetting to turn off the lights when not needed. Operation and maintenance for the HVAC system is important, especially as there is a lot of sawdust generated in the work area.

Bldg. ID WAR102 Year Built 1948

Primary Use Office - Warehouse Square Feet 19,503

Hours per week 45

Yearly Consumption - Electrical - SCL Billing

1985	234,720 kwhs	12.0 kwhs/sq.ft.
1986	201,360 kwhs	10.3 kwhs/sq.ft.
1987	180,960 kwhs	9.3 kwhs/sq.ft.

Available End Use Data

quarterly for 1987

BLDG. CHARACTERISTICS

Floors	Concrete over concrete crawl
Walls	Concrete, R11 insulation
Ceiling	Attic, R11 insulation
Windows	Tinted, double pane in metal frames
Sq. ft. windows	219

BLDG. SYSTEMS

Heating	Air to air heat pumps electric resistance backup.
Air conditioning	Air to air heat pumps.
Hot water	66 gallon electric
Refrigeration	--
Interior lights	18,400w fluorescent 2,700w incandescent - 1.1w/sq.ft.
Exterior lights	2,100w-with photo cell incandescent
Equipment I	Shop equipment
Equipment II	Office equipment

WAR102 built in 1948, was renovated and occupied by the present tenants in 1983. It is a concrete building with a parking lot on the east and south sides and against another concrete building on the north side. The marine equipment sales and service business occupies 5,492 (28%) square feet of office space, 8,022 (41%) square feet of shop, 5,374 (28%) square feet of storage and 612 (3%) square feet of loading dock. A restaurant occupies 2,728 square feet in the northeast corner of the building. The restaurant is not included in the ELCAP sample.

Insulation levels have been upgraded from the original structure. Outside walls of the heated office space and interior walls next to the restaurant have R11 insulation. Walls between office and shop have not been insulated. There is R11 blown-in insulation above the ceiling in the attic. (The walls between the restaurant and the marine refrigeration business are insulated so the heat transfer impact of one on the other is greatly reduced.) A two foot space exists between the ceiling and a suspended acoustic ceiling in the office space. The concrete on wood floor is over a concrete crawl space. The 219 sq.ft. of double pane, bronze windows are on the east and south walls, facing the parking lot. Window coverings are easily controlled by the occupants.

HVAC in the office area is provided by two air-to-air heat pumps with intake and exhaust fans with backup electric resistance heaters. The warehouse, shop and store rooms have electric resistance heaters.

As you enter the office area at the front corner of the building you leave the drab and dirty industrial area on a busy street near the noisy freeway and come into a comfortably quieter and darker interior, carpeted and decorated to reflect the marine and fishing industry served by the company. A large aquarium is just inside the door, comfortable chairs are along the front windows, and a large engine with cutouts to show its inner workings is across the reception area. Brass fish swim along the fascia above the high counter which separates the well-lit reception/office area from the lobby.

Private offices are on both sides of the center hall. Bronze glass windows with miniblinds form the walls along the hall. A back door leads to the dock, the shop and the storage areas.

Most of the interior lights are fluorescent ceiling lights. There are some incandescent lamps for task lighting and accent lighting. The crawl space, attic and exterior lights are incandescent. Exterior lights are controlled by a photocell. Hot water is provided by a 66 gallon electric water heater.

Major end use loads are individually monitored, but there are some mixed end uses, e.g., on a few wall outlets they may have refrigeration, lights and a fan on the same circuit.

The welders, grinders, drill press and other equipment in the shop are used on a consistent basis. The 40 hp electric motor is used only occasionally when a piece of heavy equipment must be tested. This will cause a high spike in consumption for a short period of time.

DATA

The quarterly data shows consistent building operation with production activity and outdoor temperatures as the major influences on energy use. As shown on the bar graphs shop equipment use and interior lights increase at the same time. When temperatures rises in the summer HVAC increases to provide cooling. In the winter the heat pumps again increase to provide heat but must also be supplemented by the electric resistance heat as the temperature falls. We see no resistance heat the other six months of the year.

One problem with the graphs in their present state becomes very apparent when one looks at the bar graphs. The KWH scale is different on each one making quarterly comparisons difficult. (0 to 15,000 for 2nd quarter of 1987. 0 to 20,000 for 1st quarter of 1987 and 4th quarter of 1986. 0 to 30,000 for the 3rd and 4th quarters of 1987). For example, at first glance June 1987 appears to have higher consumption than August 1987. However, total use in June is less than 15,000 KWH and in August it is about 17,500 KWH. Hopefully the scale will be uniform for the graphs when they reach final form.

AUDITOR'S OBSERVATIONS

A simple measure would be to change the outdoor incandescent lights to high pressure sodium for a significant savings. The occasional incandescent lights in the office area could be changed to efficient fixtures & ballasts. The incandescent lights in the crawl space and attic are used infrequently. Because of this and switching them on and off, changing them would have negligible impact on the lighting load.

HVAC runs continuously. HVAC modifications to use optium start and stop and enthalpy control should reduce HVAC load. More insulation in the ceiling would be a relatively inexpensive measure and would decrease both winter heating and summer cooling loads. Insulation installed in the crawl space would keep the feet warmer in winter. In a day time use only building the pay back would be long.

The double pane, bronze windows are an effective strategy to limit the summer sun and the heat from the asphalt parking lot. However, it does cut down on solar gain in the winter. Noise from outside is also cut down by the double pane windows.

Bldg. ID WAR103

Primary Use Warehouse

Year Built 1976

Square Feet
18,754 unheated
1,778 heated
20,532 TOTAL

Hours per week 65

Yearly Consumption - Electrical

1985)
1986) > Puget Power customer. No billing history available.
1987)

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Concrete, no insulation, one office wall wood, R-11 insulation.
Ceiling	Flat roof, R-19 insulation.
Windows	Single pane, metal frames
Sq. ft. windows	111

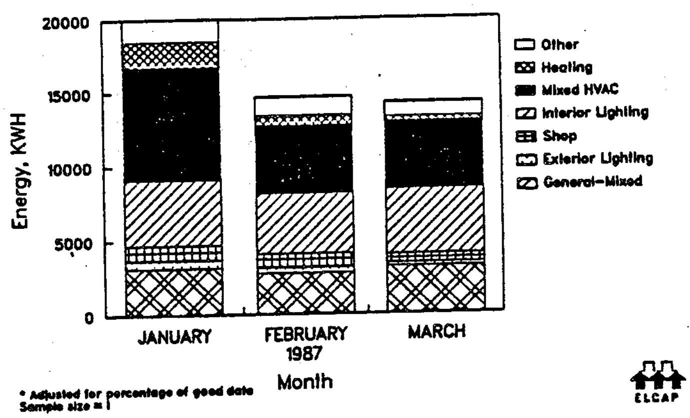
BLDG. SYSTEMS

Heating	Electric baseboard
Air conditioning	none
Hot water	6 gallon electric heater
Refrigeration	--
Interior lights	21,165 w - fluorescent 840 w - incandescent - 1.1 w/sq.ft
Exterior lights	760 w - incandescent 200 w - Mercury Vapor
Equipment I	Office equipment
Equipment II	--

WAR 102

SITE 580 1st Quarter 1987

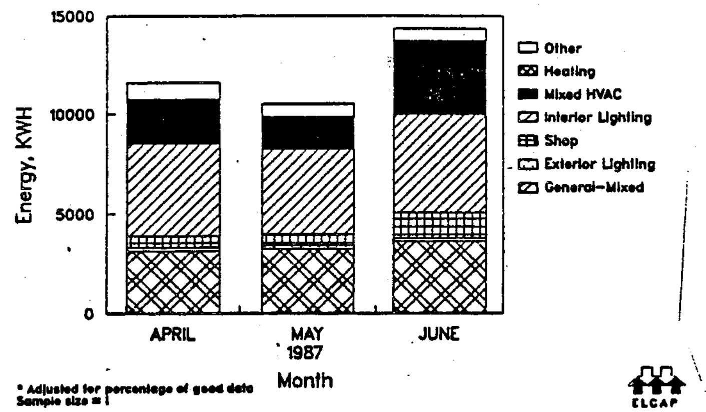
Total Monthly Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 580 2nd Quarter 1987

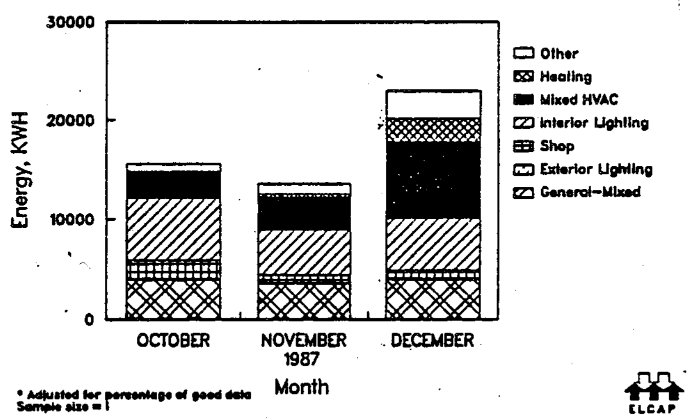
Total Monthly Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 580 4th Quarter 1987

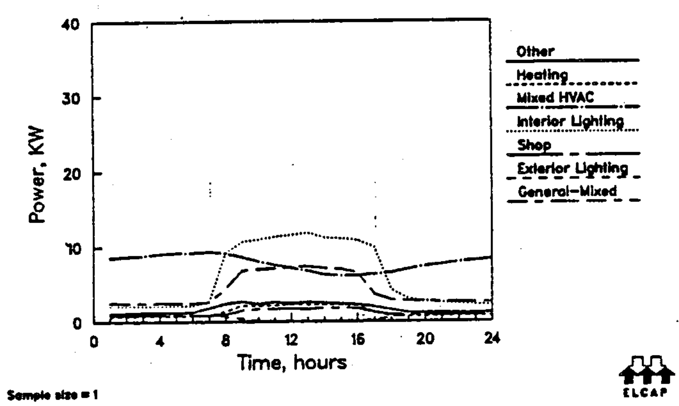
Total Monthly Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

SITE 580 1st Quarter 1987

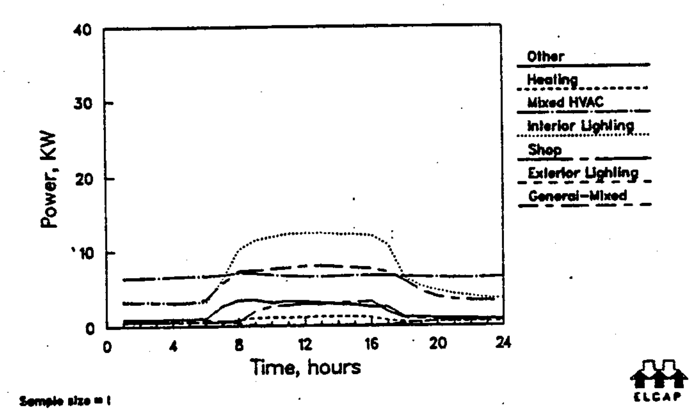
Average Daily Electricity End-Use Profile



Sample size = 1

SITE 580 3rd Quarter 1987

Average Daily Electricity End-Use Profile



Sample size = 1

WAR103 occupies two separate spaces in an industrial park area. A motor oil supply business occupies both 9,377 sq.ft. warehouse spaces and one of the front office spaces. The other 889 sq.ft. office is vacant. The exterior office walls are wood siding with three inch batt insulation. All other walls are six inch concrete. The floor is concrete slab on grade. The flat roof has six inches of batt insulation. 111 sq.ft. of single pane windows in metal frames are in the offices facing east. Each warehouse space has a front and back man door and two 8x8 metal roll up doors at the front of the building. The ceiling in the offices is 8 ft. 10 inches and in the warehouse 20 ft. The space on top of the occupied office is also used as storage area.

In practice only the occupied office is being heated using baseboard electric resistance heaters. There are gas unit heaters in the warehouse spaces but gas has been disconnected.

Fluorescent lights are installed in the warehouse areas and the offices. Incandescent lights are used in the restrooms. A pop machine, coffee maker, refrigerator, computers, adding machines and typewriter make up the plug load. A six gallon electric hot water tank supplies the rest rooms. Exterior lights are incandescent & mercury vapor.

AUDITOR'S OBSERVATIONS

We do not have any consumption data on this building as electricity is from Puget Power and enduse data is not yet available from PNL.

However, the consumption is probably low as only a small portion of the building is heated. The installed light level is 1.1 watts per square foot and many of these are burned out.

Operations and maintenance would be most important in this building. While the motor oil they deal with is all packaged it is evident that some of it breaks open and gets tracked throughout the building. As this evaporates it is bound to stick to the fins of the baseboard heaters and they should be cleaned from time to time. The incandescent lights in the restrooms could be changed to fluorescent. The exterior incandescent and mercury vapor lights could be changed to high pressure sodium.

This building pays Puget Power rates which are higher than Seattle City Light rates so the pay back on any measure is faster.

Bldg. ID WAR105 — Year Built 1978

Primary Use Wallpaper & Carpet Warehouse & office — Square Feet 33,314

Hours per week 55

Yearly Consumption - Electrical

1985 >
1986 > Puget Power
1987 >

Available End Use Data

NONE

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Warehouse - 6 inch concrete, no insulation. Office - Cedar siding, plywood and gypsum wall board, no insulation.
Ceiling	Flat built up roof, no insulation.
Windows	Single pane, bronze tinted in wood frames.
Sq. ft. windows	1,254

BLDG. SYSTEMS

Heating	Electric resistance, unit heaters.
Air conditioning	Central system, direct expansion.
Hot water	52 gallon electric heater
Refrigeration	Small
Interior lights	16,070 w fluorescent 750 w incandescent - .5 w/sq.ft.
Exterior lights	500 w incandescent > 640 w fluorescent > on time clock. 300 w Mercury Vapor>
Equipment I	Office equipment
Equipment II	Saws, vacuum pump motor, air compressor, cutting machine, etc.

Bldg. ID WAR106 | Year Built 1968

Primary Use Warehouse, retail | Square Feet 19,446

Hours per week Varies by business 60 hours of some level of occupancy

Yearly Consumption | Available Data

1985	-	History is unclear.	NONE
1986	-	(This appears to be incomplete, for	
1987	-	only the mail handler, not entire building).	

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Six inch precast concrete, finished with sheet rock. Walls between warehouse & offices have R-11 batt insulation.
Ceiling	Flat built up roof, R-11 insulation.
Windows	Bronze tinted single pane in aluminum frames.
Sq. ft. windows	1,268
Sq. ft. doors	480

BLDG. SYSTEMS

Heating	Gas Furnaces
Air conditioning	4 direct expansion air conditioners
Hot water	2-40 gallon electric water heaters
Refrigerator	---
Interior lights	20,415w fluorescent 1,785w incandescent - 1.14w/sq.ft.
Exterior lights	900w incandescent, Photo cell
Equipment I	Bulk mailing equipment
Equipment II	Office machines

WAR106 is a two story marble crete warehouse - office building built in 1968. At the front of the building, on each floor there are four 1000 sq.ft. office spaces. At the back of the building there are four, 2,700 sq.ft., warehouse spaces with 21 ft. ceilings. Some of the front office people use these spaces. Other offices are independent of any other space. When the original survey was done in October 1985 there were three tenants occupying the first floor, one using two of the spaces. On the second floor one of the office spaces was vacant, one was occupied by the double tenant, one and a half by another tenant and a half of an office space by a small tenant which hires out clowns.

In January 1987 one of the first floor tenants had moved and the double tenant took over the space, giving them three fourths of the entire first floor area. The 1½ space tenant on the second floor had left leaving the space empty. In November 1987 most of the tenants moved out; the junk mailer who had been the largest tenant, the temporary unemployment office, and the sales rep. Then in March and April, 1988, new tenants moved in. A wholesale costume jewelry and gift business took over one of the warehouses and a front office. A stained glass window wholesaler was in one warehouse and office. A measuring tape manufacturer was in one warehouse and an upstairs office. A moving company was in the other warehouse and front office. The other offices were vacant. In February 1989 the stained glass company moved out, and two other offices were vacant.

There seems to be a lot of turn over in this building. The only original tenants still there after three years were the advertising office and the clown agency.

The bulk mailer used a lot of automated mail handling equipment, which of course left with him. The newer tenants do not have any large equipment. The measuring tape manufacturer uses pneumatic equipment.

The building is arranged with two stairwells and entrance lobbies, giving each office space direct access doors. On the first floor restroom are off the back of the lobby. On the second floor these areas contain janitor store rooms and small kitchens.

The outside walls of the building are precast concrete, finished on the inside with gypsum wall board, there is no insulation in them. However, the walls between the office spaces and warehouse spaces do have R-11 fiber glass batts in them. This was used for a sound barrier rather than for insulation. These walls are finished on both sides with gypsum wall board.

The entire flat, built up roof has R-11 insulation. In the offices there is a suspended, acoustic tile ceiling. The floor is concrete slab on grade. All of the office windows face south. They are single pane, bronze tinted in metal frames. There are draperies to help control the lighting.

The entrance doors, also on the south side are clear single pane glass in aluminum frames. The 10 x 12 metal warehouse doors on the north side have 40 sq.ft. of glass windows which provide some daylight in those areas.

Individual HVAC systems serve each area. Because of the way the spaces are split and combined it presents a confusing picture. However, the tenants in each area are able to control their area. The system serving the common areas is controlled by timers to have the heat on from 6 am to 8 pm. Each of the eight systems has a gas furnace. Four offices also have air conditioning.

OBSERVATIONS

The tenant turn over has not affected the original structure or the building HVAC systems, as new tenants have just changed equipment and furniture. The mail handler did have more equipment than the subsequent tenants so there should have been a drop in the plug load when he moved out.

RECOMMENDATIONS

The lighting could be changed from incandescent and fluorescent to efficient fluorescent with efficient ballasts. Occupancy sensors in seldom used areas would reduce the number of hours the light would be on in those areas.

Small or instantaneous hot water heaters to replace the 40 gallon tanks would be a comparatively large investment but, heating 80 gallons of water 24 hours a day, 7 days a week is also expensive. Occasional hand washing and light kitchen clean up produce only a minimal demand.

When air conditioners need to be replaced, heat pumps should be considered. They would provide cooling and, in our mild climate, could provide very efficient day time heat most of the year. The gas furnaces could be used for morning warm up and for back up heat for the occasional low temperature days.

Bldg. ID WAR110	Year Built 1961
Primary Use Wholesale + warehouse	Square Feet 49,769

Hours per week 45 hours - occasional evening hours

Yearly Consumption - Electrical - SCL Billing   Available End Use Data

1985	147,160 - 2.96		NONE
1986	172,080 - 3.46	= 3.32 average	
1987	175,440 - 3.53		

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Office - Aluminum, wood or masonry, with R-7 insulation. Warehouse - Concrete
Ceiling	Office - Flat built up roof. R-19 insulation dropped ceiling. Warehouse - Flat built up roof, no insulation.
Windows	Office - Clear single pane, metal frames.
Sq. ft windows	Office - 707 sq.ft.
Doors	Warehouse - 432 sq.ft. roll-up doors.

BLDG. SYSTEMS

Heating	Office in warehouse, restrooms - baseboard electric resistance. Main warehouse and offices - forced air gas furnaces.
Air conditioning	2 roof top and 3 room air conditioners
Hot water	6 gallon - electric 20 gallon - electric
Refrigeration	--
Interior lights	1,050w HID 31,138w fluorescent 2,706w incandescent - .68 w/sq.ft.
Exterior lights	740w incandescent 350w HID
Equipment I	Heavy shop equipment
Equipment II	Office equipment

WAR110 houses a wholesale machine parts business. There have been no structural changes since it was built in 1961. There have been some equipment changes since the original survey was completed in 1985. In December 1987 a new energy management system was installed to replace the old one that did not operate properly. At the same time a destratification fan and two exhaust fans were installed in the warehouse. The exhaust fans operate primarily to clear the air when the gas driven fork lift operates in the warehouse. Outside, at the back of the building, mercury vapor lights were installed in place of the incandescent lights.

The 4050 sq.ft. oblong office area extends out from the north side of the warehouse. The office walls are aluminum, wood or masonry with R-7 insulation and are finished on the inside with gypsum wall board. The windows are clear, single pane, in aluminum frames; 364 sq.ft. on the west side facing the street, 288 sq.ft. on the east side facing the yard area behind the warehouse and 55 sq.ft. facing north. About half of the windows can be opened. Metal miniblinds are installed on all the windows. There are also small metal awnings on the west windows. The ceiling is a flat built up roof with R-19 insulation, an air space and a dropped ceiling. The floor is slab on grade.

The 45,719 sq.ft. warehouse has five inch concrete walls. The top 2.5 ft. of the 23 ft. high walls are corrugated fiber glass, originally intended to admit light, but they are now covered with R-11 batt insulation. The large, steel, roll-up doors use 432 sq.ft. of the wall area. The flat roof is uninsulated. The floor is concrete slab on grade.

Interior lighting is fluorescent tube ceiling fixtures in all areas of the building with a few incandescent fixtures in hallways and in lamps for task lighting and HID in some areas of the warehouse to provide good light levels. Exterior lights are incandescent and a few new mercury vapor lights.

The main heating system has four, forced air, gas furnaces. Warehouse office, tool room, rest room and two corner offices have electric resistance, baseboard heaters. Air conditioning is provided by two direct expansion roof top units and by three small window units in individual offices. One problem with the cooling system is that it only supplies the center vents in the office area and does not feed into the outer vents like the forced air heat does. This makes it uncomfortable along the west wall of the office when the weather is warm. Even with the awnings on the windows and green plants next to the building the employees feel too warm.

The office operates from 8:30 am to 5 pm, Monday through Friday. Ocassionally someone will work on the weekend. In May 1988 the company held its first in house trade show. At that time all equipment was used to capacity. The warehouse operates from 8 am to 4:30 pm. Some of the heavy equipment is used infrequently but when it is used it is a large load. There are drill presses, grinders, milling machines, chain saws, band saws, abrasive saws, lathes, hoists, paint mixer, pumps, battery charger, welder, cutter, scraper and other equipment in the machine shops.

OBSERVATION AND RECOMMENDATIONS

The manager feels the new destratification fan has made the warehouse much more comfortable and they may install two more to drive more heat down to the floor level. He thinks the new EMS system has saved them up to $2000 a month in gas bills as before the whole warehouse was being heated 24 hours a day, 7 days a week. The change in exterior lights has provided more security to the yard with little change in wattage.

The incandescent interior lights could be changed to efficient fluorescent, the incandescent exterior lights could be changed to HPS. Several of the warehouse lights could be changed out to high pressure sodium. The color rendition of HPS lights is improving and they could be very acceptable to the workers.

Room sized heat pumps could be used instead of the window air conditioners and the baseboard heaters.

The 20 gallon water heater could be replaced by a small, at the source, water heater. Now the water in the kitchen must be run a long time before it is hot enough as it comes all the way from the warehouse.

Bldg. ID WAR301 Year Built 1983

Primary Use Greenhouse-sales Square Feet 8,000

Hours per week 70

Yearly Consumption - Electrical - SCL Billing

1985 - 160,800 kwhs - 20.1 kwhs/sq.ft.
1986 - 168,400 kwhs - 21.0 kwhs/sq.ft.
1987 - 169,720 kwhs - 21.2 kwhs/sq.ft.

Available End Use Data

March 1987

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade
Walls	Cinder block with filled cores, R value - 5
Ceiling	Suspended ceiling - R-30 insulation
Windows	Double pane
Sq. ft. windows	270 sq.ft. skylights 525 sq.ft. windows

BLDG. SYSTEMS

Heating	Forced air gas
Air conditioning	Direct expansion
Hot water	52 gallon electric
Refrigeration	--
Interior lights	7700 w fluorescent 500 w incandescent - 2 w/sq.ft. 8000 w metal arc
Exterior lights	2300 w fluorescent 300 w HPS 100 w neon

WAR301 is entirely different from the other warehouses in the ELCAP sample. It was built in 1983, but modified when the present occupant, a retail nursery, moved in. The modifications included adding 270 square feet of skylights, 345 square feet of south facing and 180 square feet of east facing windows. This retail nursery specializes in large indoor plants. Their plant service also cares for plants in customer's buildings.

The main floor has a 5680 square feet of display/sales area. The trees and other plants of all sizes create the effect of being in the woods. At first you do not see the sales table and cash register as they are near the back, behind the trees. Other supplies, equipment and some artificial flowers are off to the sides. The ceiling is 18½ feet above the floor. A 1160 square feet, two level section is at the back of the building. Restrooms, employee kitchen, work space and storage are on the first floor. The second floor has offices and more storage areas. Windows from the office provide an overview of the display area.

The floor is concrete slab on grade. The walls are eight inch cinder block with filled cores giving them an R-5 value. The suspended ceiling has R-30 batt insulation. The most notable feature of the facility is the interior lighting for the forest of plants. Basic building lighting is fluorescent ceiling fixtures. In addition, special metal halide grow lights produce a very bright atmosphere.

There is abundant daylighting from the double pane skylights and windows. There are also glass entry doors on the south. The other doors are 10 ft. x 10 ft. metal roll up doors, one on the south and one on the east side of the building.

HVAC system consists of a gas forced air ceiling mounted furnace, a direct expansion air conditioner, a heat rejection fan, a supply ventilation fan and four air stratification fans. The stratification fans are on 24 hours a day and are monitored on the heat auxiliary channel. The interior lights have a capacity of 16.2 kw, as much as a furnace. Indeed they do furnish the majority of heat to the building. The plants require a constantly conditioned building. They must be protected from extreme heat or extreme cold.

Exterior lighting has a capacity of 2.7 kw and becomes a significant load since most of it is on 24 hours a day. The large sign and fluorescent lights under the canopy are on 24 hours a day. The high pressure sodium lights in the parking light are controlled by photocell.

The store is open from 10 a.m. to 5:30 p.m. but employees are there from 8 a.m. to 6 p.m. The owners may be in at 6 a.m. to get things started. The store is closed only on Christmas, New Year's, Thanksgiving and the Fourth of July.

We have reliable data for March 1987. Total consumption was 15,286 kwh. Graphs #1 and #5 show 66.4 percent of the load was for interior lighting. Exterior lighting was the next highest consumer with 15.7 percent of the total load. The mixed HVAC and the auxiliaries are mostly for ventilation and cooling and only add up to 6.3 percent of the total. Water heating and equipment such as the refrigerator, cash register, copy machine, typewriter and some plug-in lamps make up the last 14 percent of total consumption. Most loads show a steady use over the 24 hour day with only a slight increase due to business being open. Interior lighting is the dramatically difference, see graph #3. This load drives the shape of the daily use, shown on graph #4. Graph #2, the week-end use shows that on Saturdays and Sundays the employees do not arrive as early, interior lights are not turned on as early and less hot water is used. However, the other loads stay constant.

Auditor's Observations and Recommendations:

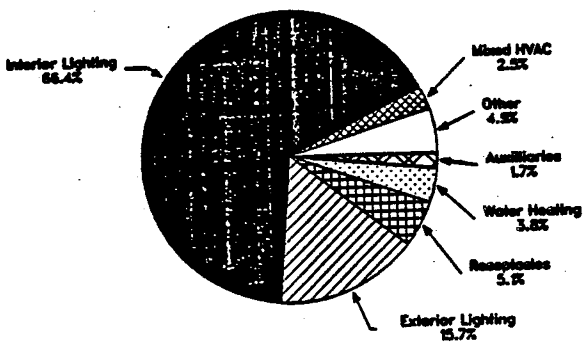
1. The exterior signs are left on 24 hours a day. These could be controlled by a time clock which would turn them off late at night when their advertising value is low, and turn them back on for business hours and early evening when there is a large volume of traffic on the thoroughfare running past the building. The interior lights that are left on and the parking lot lights provide security at night. The high amount of interior lighting is necessary for the growth of the plants. For those few hours the lights are turned down at night the demand on the heating system would be increased when the weather is cold.

2. The 52-gallon hot water tank should be turned down to 120° F as there is no need for 140° F water. It should be replaced by a small, superinsulated tank since there are no dramatic peaks in hot water use. Most of the demand is from standby loss.

3. The original structure was not intended for a plant production operation and the walls are only R-5, for a warehouse. Since the space is conditioned 24 hours a day, the thermal values of the various construction components are important. However, because of the hot lights, heat dissipation is probably of greater concern than retaining heat except at night in the coldest part of the winter. Covering the windows to cut the solar gain in summer and retain heat in winter would be far less expensive and could be easily controlled.

SITE 300 3/ 1/87 to 3/31/87

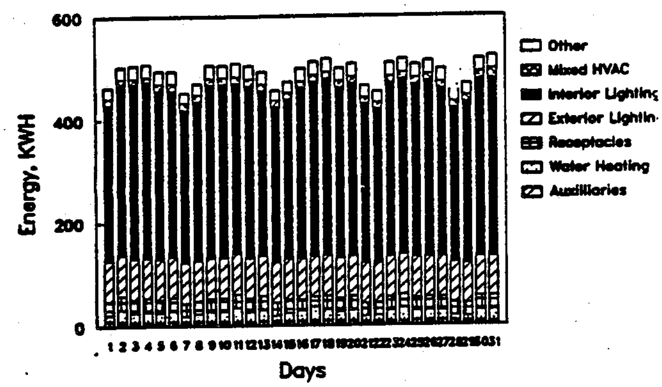
Share of Total Electricity Consumption 15,286 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

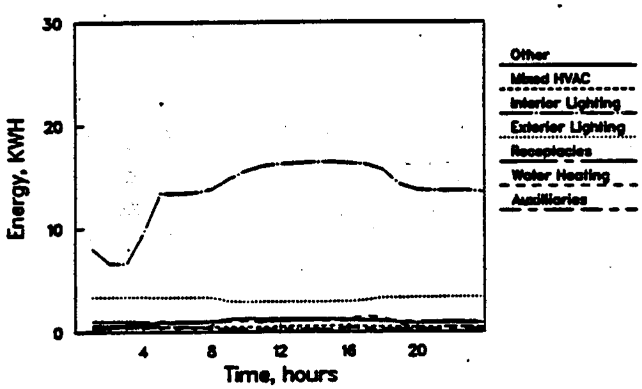
SITE 300 3/ 1/87 to 3/31/87

Total Electricity Consumption by End-Use *



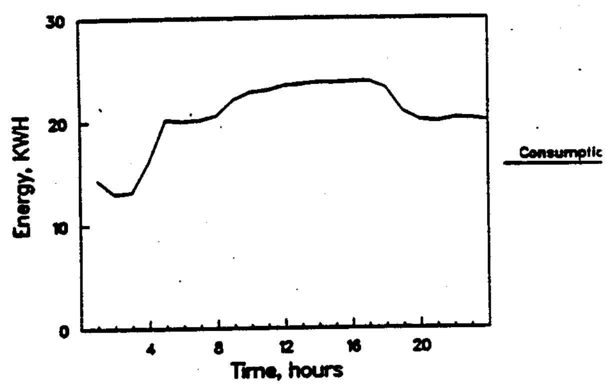
SITE 300 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



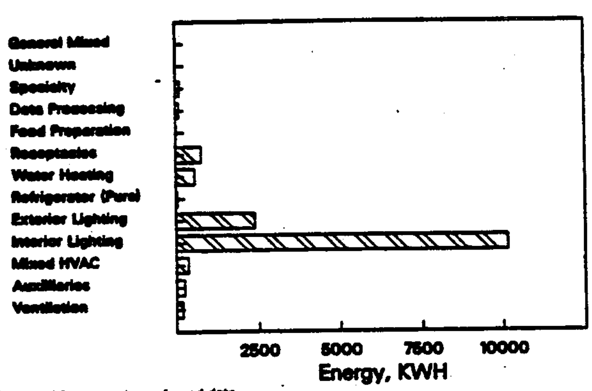
SITE 300 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



SITE 300 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID WAR302	Year Built 1983
Primary Use Office	Square Feet 3,666 conditioned 1,581 unconditioned 5,247

Hours per week 45

Yearly Consumption - Electrical - SCL Billing

1985 - 19,680 - 3.8 kwhs/sq.ft.
1986 - 21,840 - 4.2 kwhs/sq.ft.
1987 - 22,080 - 4.2 kwhs/sq.ft.

Available End Use Data

October 1986

BLDG. CHARACTERISTICS

Floor	Concrete - slab on grade
Walls	Concrete R-11 insulation
Ceiling	Flat built-up roof - R-19 insulation
Windows	Double pane in metal frames
Sq. ft. windows	325

BLDG. SYSTEMS

Heating	Gas fired boiler
Air conditioning	Direct expansion
Hot water	50 gallon electric
Refrigeration	--
Interior lights	7,034 w fluorescent 2,055 w incandescent - 1.7 w/sq.ft.
Exterior lights	100 w incandescent 160 w Mercury vapor
Equipment I	Office equipment
Equipment II	Shop equipment

WAR302 is an attractive concrete and steel warehouse and two-story office building in the industrial area of Seattle. The business is a wholesale supplier of furnace equipment. The office area walls are furred out, have R-11 insulation and are covered with gypsum wallboard. The enclosed entry and stairway at the northwest corner and the warehouse across the south have 18.5 ft. ceilings. Office ceilings are 8.5 feet.

There is R-19 insulation in the ceiling. The floor is slab on grade concrete. Windows are double glazed in metal frames. All face across the north front of the building. The entrance lobby is completely enclosed, providing an airlock entry, a very desirable feature.

The 1833 sq. ft. of office, restroom and kitchen spaces on each of the floors are served by a central gas boiler heating system and by conventional air conditioners. Domestic hot water comes from a 50 gallon electric water heater.

The 1581 sq. ft. warehouse and mechanical room are unconditioned spaces, but do have the waste heat from the boiler and motors and an intake fan for outdoor air.

Inside lighting is provided by ceiling mounted fluorescent fixtures in the offices, kitchens and warehouse. Incandescent lights are used in the restrooms and in the entrance. Exterior lights total only 260 W with one incandescent and one mercury vapor fixture which are on a timer.

The end use loads are identified on separate channels with little mixing of end uses.

There are very few customers coming into the building, maybe eight a day. Most customer contacts and sales are conducted by phone or mail by the nine employees. Operating hours are 8 a.m. to 5 p.m. five days a week.

When the original survey was done, the second floor office space was vacant. However, the business has expanded and separate rooms have been walled off with one new employee. Limited use of the second floor space began the middle of April 1987. The only new equipment added were two computers and terminals and a printer.

From the billing history and from the end use graphs we see low electric consumption in this commercial building. It has gas heat, therefore a substantial energy load is not accounted for in the electric end use graphs. In the graphs we see interior lighting dominating and shaping the electric load.

Unfortunately, we have only a few days of reliable data from October 1986. But the regular daily patterns are fairly consistent, showing the week day and the weekend uses. On some Saturdays or Sundays someone is in, turns on a few of the lights and data processing equipment. One interesting observation from graph #2 is the consistency of the water heater load, whether it is being used or not. This, along with graph #3, shows the standby loss of the water heater accounts for well over half of the water heater load. In this building this is a small loss, but on a larger scale it could be a significant one.

Auditor's Observations and Recommendations:

1. In new construction or if the tank needs to be replaced an "at the source" water heater or a small six gallon tank should be considered.

2. Interior lighting levels could be maintained with less wattage by replacing the overhead fluorescent fixtures with fixtures equipped with reflectors, efficient ballasts and efficient fluorescent tubes. Fluorescent task lighting might be more comfortable for the workers and overhead lighting could be decreased in some areas. Incandescent lamps in rest rooms, entry and exterior could be changed to fluorescent. Exterior lights should be changed to High Pressure Sodium.

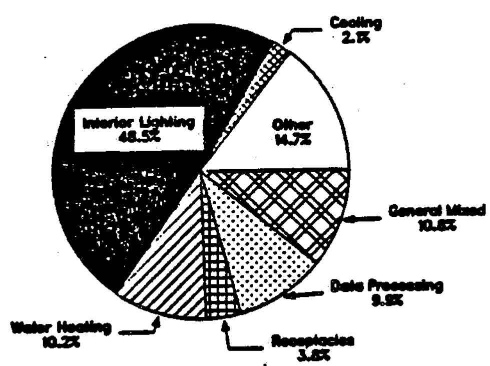
3. Both sets of entry doors need to be kept closed when not being used to take full advantage of the air lock entry. The day of the revisit one was propped open.

4. The building is relatively new and met energy standards when built in 1983. There is space above the ceiling and more insulation could be added. This would be an expensive measure and would lower the winter heating load and the summer air conditioning load but, at this time, probably not enough to be cost-effective.

5. The north facing windows do not have the direct solar gains south or west windows would have, fortunate in the warm weather, but not on the cold days. Draperies on the windows could cut some of the heat loss in winter and some of the heat gain in summer.

SITE 294 10/ 1/86 to 10/31/86

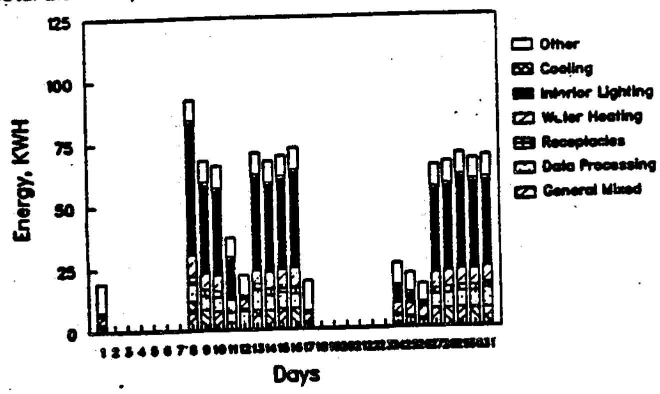
Share of Total Electricity Consumption 1,767 KWH by End-Use *



* Adjusted for percentage of good data
Sample size = 1

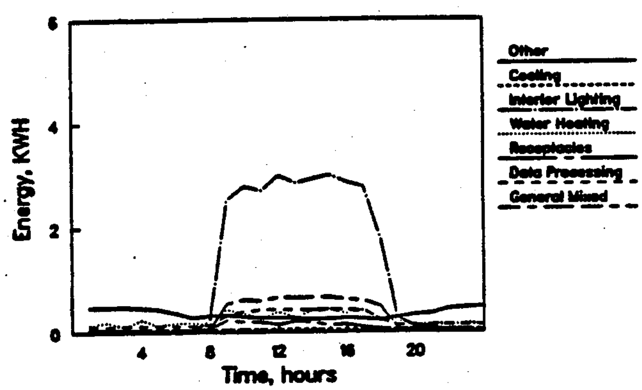
SITE 294 10/ 1/86 to 10/31/86

Total Electricity Consumption by End-Use *



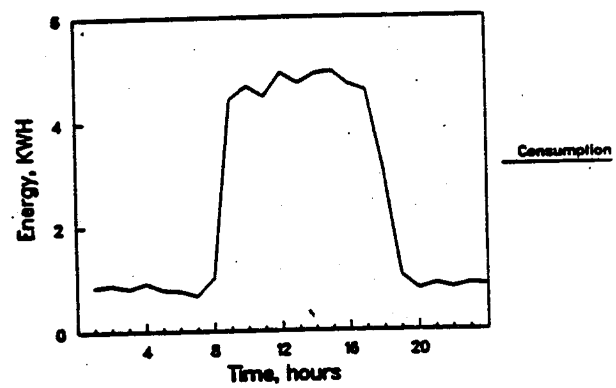
SITE 294 10/ 1/86 to 10/31/86

Average Daily Electricity End-Use Profile



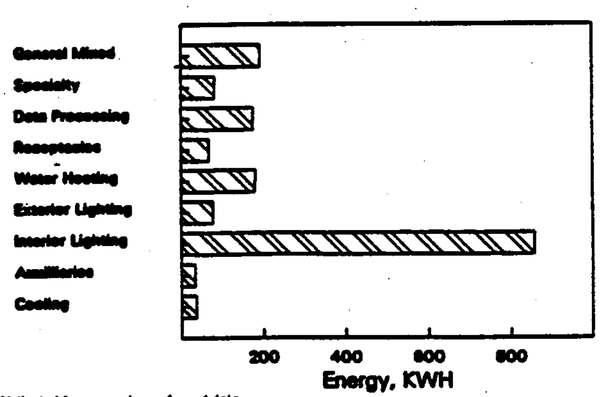
SITE 294 10/ 1/86 to 10/31/86

Average Daily Total Electricity Use



SITE 294 10/ 1/86 to 10/31/86

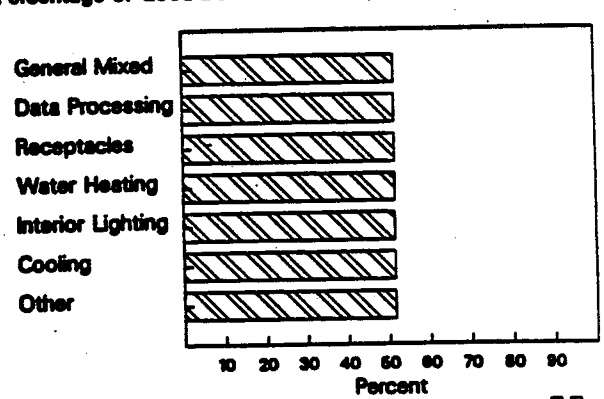
Total Consumption by End-Use *



*Adjusted for percentage of good data
Sample size = 1

SITE 294 10/ 1/86 to 10/31/86

Percentage of Good Data



* Adjusted for percentage of good data
Sample size = 1

ELCAP

Bldg. ID WAR303 Year Built 1982

Primary Use Warehouse Square Feet 12,000

Hours per week 42.5

Yearly Consumption - Electrical - SCL Billing

		Available End Use Data
1985	One meter for entire complex.	November, 1985
1986	This building is not metered	March 1987
1987	separately	

BLDG. CHARACTERISTICS

Floor	Concrete slab on grade.
Walls	Metal, R-13 insulation.
Ceiling	Metal, R-3 insulation.
Windows	Skylights, double pane, tinted.
Sq. ft. windows	144

BLDG. SYSTEMS

Heating	4 electric resistance 25,000w heaters with blower; 3 electric 1,250w baseboard.
Air conditioning	None.
Hot water	20 gallon electric.
Refrigeration	None.
Interior lights	100 w fluorescent 19,200 w HPS - 1.6 w/sq.ft.
Exterior lights	1,400 w HPS, on photocell
Equipment I	--
Equipment II	--

WAR303 is located down by the sea. It is one of many buildings in a large, busy complex, a part of the marine industry in Seattle. This all-electric warehouse was built in 1982. It has metal siding with four inch, vinyl covered batt insulation. The slanted metal roof also has the four inch insulation. Four double glazed plastic skylights occupy a small area of the roof. The floor is uninsulated slab on grade concrete. The 14 x 20 and 9 x10 metal doors are not insulated. The three "man" doors are insulated steel doors. The ceiling is 26 ft. high at center and 22 ft. at side walls.

Heat is provided by four forced air electric furnaces located near the ceiling. Eight paddle fans drive the heated air down. Walled off restrooms are located in one corner and have their own electric resistance heaters.

The cavernous 12,000 sq. ft. building has shelves down one side and a double row in the center. Engines and other large equipment are lined up along the other wall. Giant spindles hold rope and cable of all sizes, made of hemp, synthetic material or steel. Various spare parts, sea chests and motors are stored on the shelves. On the back loading platform are the reelers that handle the hugh rope. Wooden pallets, metal and plastic drums and old tires are stored in the fenced yard on the back and side of the buildings.

Interior lighting is provided by 24 high pressure sodium (HPS) ceiling lights. Exterior lighting is HPS controlled by a photocell.

Occupancy of the building is low, with maybe one person or no one there. Occasionally, there will be more workers if a large quantity of material must be handled.

Near the end of 1987 there may be some major changes within the building. A freezer/cold storage building may be placed inside the warehouse. This would add a major electric load year around. The waste heat from such a facility would warm the original building, decreasing the cold weather heating load but would also require venting in the warm weather.

The electrical end use loads are neatly separated, very little mixing of uses on the same circuit.

Data:

The end use load information for this building looks different than expected. Heat is a much greater load than is usually seen for a warehouse. We have the usual graphs for March 1987 and also some 3D graphs for November 1985.

Graph #1 shows 80 percent of the load for heating. Graph #2 shows heating consuming more on weekends when the lights are not on to help heat the building. Graph #3 shows greater nightime use for heat than daytime use.

The last half of November 1985 was unusually cold for November. This cold spell is reflected in the graph for heat (HEA). Interior lights (ILT) show the normal day and night use with weekend use dropping off sharply. It also shows one night when the lights were on and toward the end of the month the interior lights were on all the time. Other loads are also seen to be on at those times. The 3D graphs show the sporadic use of the equipment and show which hour of which day they were used. This is impossible to determine from a regular #3 graph.

Auditor's Observations:

The heating system should not be used a great deal due to low occupancy of building and people working inside are usually dressed for the outside climate. With the addition of the cold storage facility, the greater need could then be for ventilation of the warehouse when the weather is warm.

The building shell is insulated, the lighting is all efficient lighting.

Recommendations

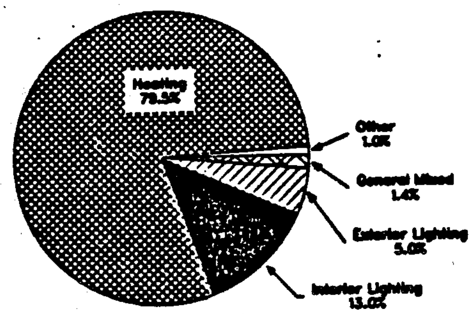
1. Considerable savings could be achieved by better control over the heating systems. Automatic thermostats in locked boxes would provide heat during working hours and assure it would be turned off during non-working hours.

2. Motion sensors for the lights would turn them on only when the particular area is occupied.

3. The heating system could be changed over to heat pumps. While this would be expensive and would contribute to the summer load, it should decrease the winter load which is now using 100 percent electric resistance heat.

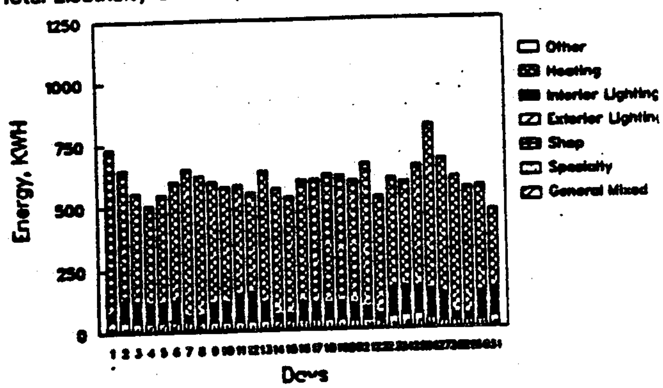
SITE 282 3/ 1/87 to 3/31/87

Share of Total Electricity Consumption 18,722 KWH by End-Use *



SITE 282 3/ 1/87 to 3/31/87

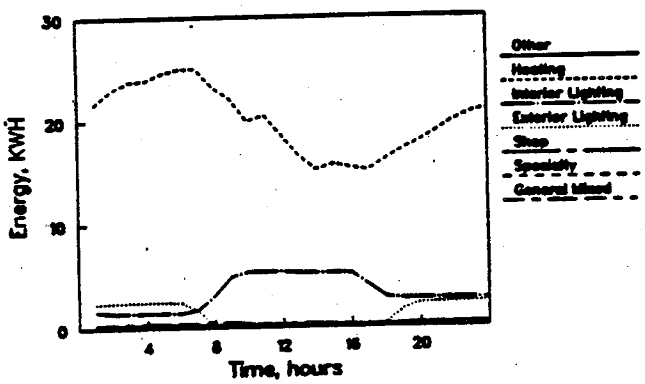
Total Electricity Consumption by End-Use *



* Adjusted for percentage of good data
Sample size = 1

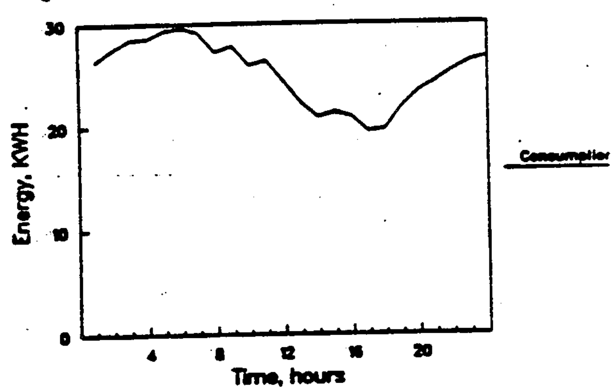
SITE 282 3/ 1/87 to 3/31/87

Average Daily Electricity End-Use Profile



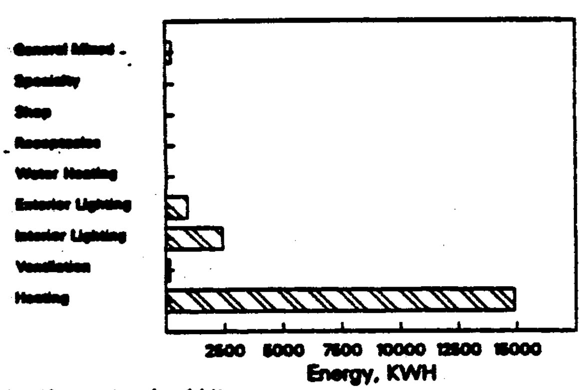
SITE 282 3/ 1/87 to 3/31/87

Average Daily Total Electricity Use



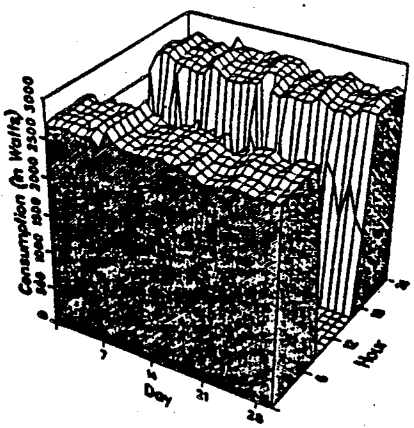
SITE 282 3/ 1/87 to 3/31/87

Total Consumption by End-Use *



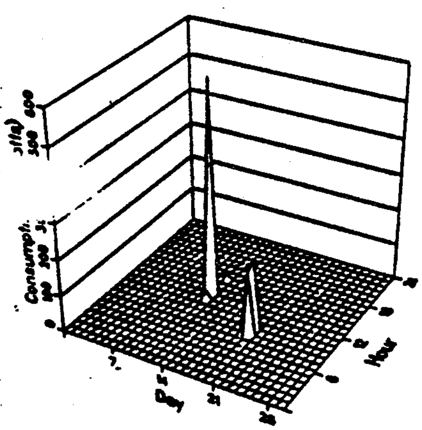
*Adjusted for percentage of good data
Sample size = 1

Site 0282 November 1985



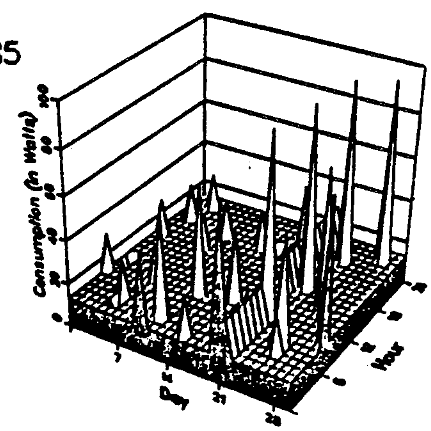
OLT END-USE

Site 0282 November 1985



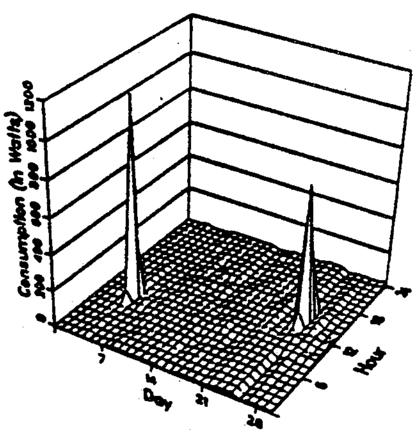
PLG END-USE

Site 0282 November 1985



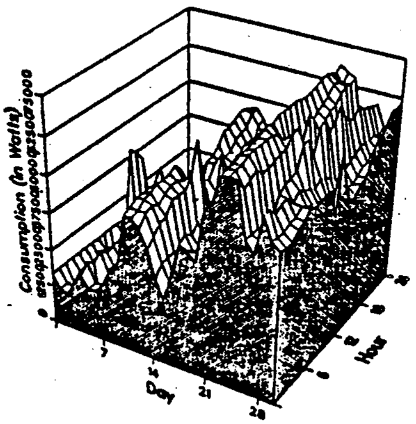
SP1 END-USE

Site 0282 November 1985



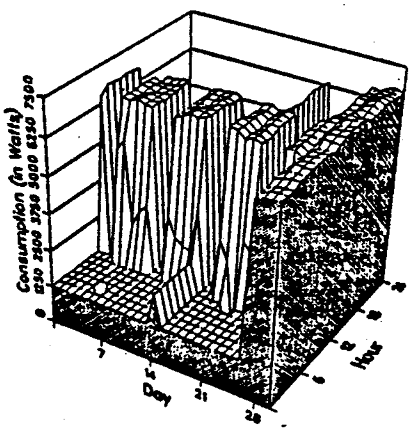
SHP END-USE

Site 0282 November 1985



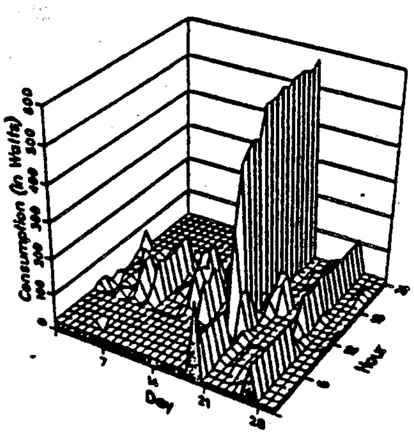
HEA END-USE

Site 0282 November 1985



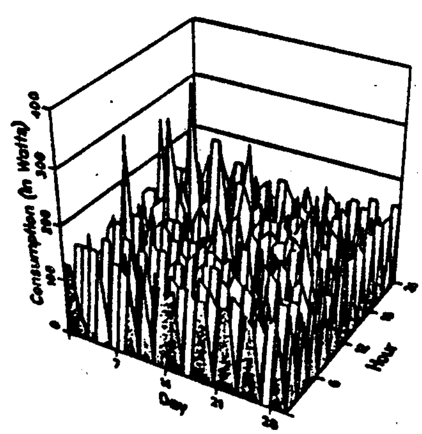
ILT END-USE

Site 0282 November 1985



GEN END-USE

Site 0282 November 1985



H20 END-USE