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ABSTRACT

Energy cost management is important in all school food service operations, particularly at times when rising energy costs threaten budgets. This document is designed as a reference manual on energy and provides information about monitoring energy use and developing energy improvement and conservation plans. The manual offers energy conservation ideas at two levels for existing school food service production and service: (1) non-technical and low cost enhancements; and (2) capital investment and systems changes. The manual is adaptable to the needs of food service managers so they can more easily and efficiently run their operation by learning how to organize an energy planning team as well as conduct audits of utility bills in order to lower production costs. Concluding sections provide a glossary of terms and equations, sample energy records forms, and technical information regarding reading utility company meters and BTU Rating lists for various equipment. (GR)

ENERGY CONSERVATION MANUAL FOR SCHOOL FOOD SERVICE

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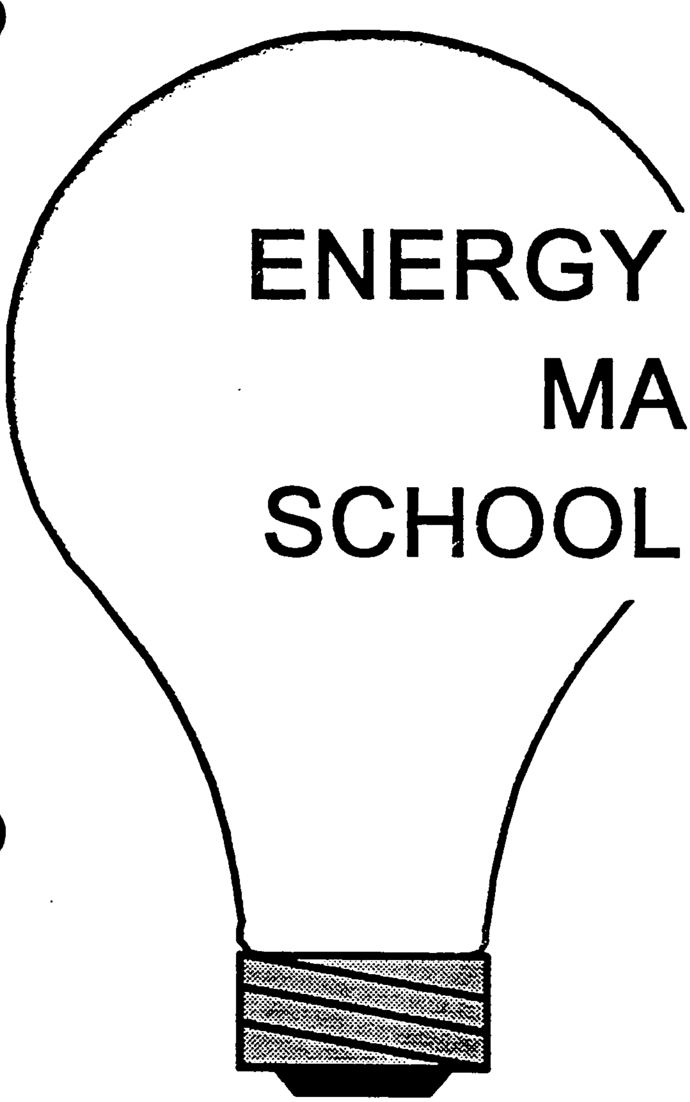

ENERGY CONSERVATION MANUAL FOR SCHOOL FOOD SERVICE

ENERGY CONSERVATION MANUAL
FOR
SCHOOL FOOD SERVICE MANAGERS

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PREFACE

The management of resources to reduce expenses is important in any school food service operation, and energy is one resource that can be conserved. Energy costs fluctuate dramatically depending on the price of oil, and at some times are very expensive which necessitates conservation. This manual is designed to be a reference on energy. It includes information about monitoring energy use and developing energy improvement and conservation plans. School food service personnel at the school and district levels can use this manual in their programs to improve use of energy and control costs..

This manual resulted from a research project that the National Food Service Management Institute funded at Oregon State University. A study of energy consumption was conducted and served as a basis for developing this manual. Results of that study have been published and the citation for the study is included in the reference list included in this manual.

We would like to express appreciation to Dr. Ann M. Messersmith, Dr. George Wheeler, and Ms. Victoria Rousso of the Oregon State University for developing the content for this manual on energy conservation. We also would like to recognize the contributions of the following individuals: Larry Isitt, a doctoral student in English at the University of Southern Mississippi who edited the manual for wording and style; Drs. Mary Frances Nettles and Mary Gregoire for reviewing the manual for content and consistency; Ms. Lisa Barrett for typing and formatting the manual; and Ms. Shonia Gipson for typing portions of the manual.

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This manual was developed through a grant provided by the National Food Service Management Institute. This project also included a research project on energy consumption in school food service. We appreciate the cooperation of school food service directors in the school districts that participated in the research study. We hope that school food service managers and directors/supervisors will find this manual useful in their food service operations.

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INTRODUCTION

The food service industry uses large amounts of electricity, gas, and steam, which, if managed efficiently, contribute to more effective food service operations.

School food service managers need to monitor and control energy use to this end. This is not easily done since managers often must work with old equipment and in buildings where food service shares facilities with classrooms, gymnasiums, libraries, restrooms, heat plants, and other energy using areas which often have different energy needs and operating schedules, but yet are controlled as one unit.

Energy conservation requires a group effort. School food service managers must promote energy conservation efforts with food service staff, including providing them with training. These energy conservation efforts can be shared with students, teachers, administrators, and families since environmental concerns are shared by many people. Involvement in conservation can provide a positive image for the school food service program.

Objectives

This *Energy Conservation Manual for School Food Service Managers* will assist managers in developing an ongoing program of energy conservation. By doing monthly energy audits, the manager can make smarter energy-related decisions regarding record keeping, audits, production planning, and conservation techniques for food service. The manual can serve as a reference document for ongoing energy management in school food service. This manual helps school food service managers to:

- track and organize energy use from utility bills,
- estimate energy use, and
- make operational decisions that will lead to a cost effective operation.

Energy conservation is the result of carefully planning equipment and operating techniques to reduce the use of energy. The conservation of energy has two major outcomes: (1) less natural resources are used, and (2) costs are reduced.

Organization

The manual offers energy conservation ideas at two levels for existing school food service production and service: (1) non-technical and low cost enhancements and (2) capital investment and systems changes. As you will see, we've made the manual adaptable to your needs as a food service manager so that you may more easily and efficiently run your operation by learning how to organize an energy planning team as well as conduct audits of utility bills so that you may lower production costs. We've provided sections of the manual for references, glossary/equations, sample forms, and technical information.

ENERGY MONITORING: ORGANIZATION AND PROCEDURES

Two teams are needed to incorporate energy conservation and control into day-to-day activities: Energy Planning Team and Energy Operational Team.

Energy Planning Team

The Energy Planning Team members, who are the key personnel in planning and controlling energy use, must develop knowledge of the major factors effecting food service energy use. This knowledge will provide them with overall qualitative and quantitative information from which to plan their energy program.

Team members include (1) the school food service manager, (2) the maintenance/physical plant engineer/supervisor, (3) utility company technical professionals, (4) a school administrator, and (5) a food service personnel representative. Team members participate in planning and developing the school food service energy conservation program.

An effective team requires commitment from the food service manager and school administrator. Energy conservation needs to be managed as any food service function, activity, or resource. Therefore, the food service manager is the team leader and should assume responsibility for energy conservation. In some instances, the food service manager may select an energy coordinator and give both the responsibility and authority to that person.

Energy Operational Team

The Energy Operational Team includes (1) the school food service manager, (2) food service personnel, (3) maintenance/physical plant engineer/supervisor, and (4) a representative from the Energy Planning Team. The purpose of this team is to manage energy in all *operational functions*.

Energy management is intertwined with other operational functions such as menu development, production scheduling, storage, and distribution. Therefore, it is reasonable for the school food service manager to meet regularly with the energy operational team throughout the year.

The coordination of the energy planning and operational teams again becomes the responsibility of the school food service manager. Communication serves as the key to integration of energy management and conservation.

Organizing Resources

Begin energy monitoring by collecting data that are immediately available from your food service facility. These include utility bills, energy submetering records, equipment specifications, customer meal counts (census), and any past energy monitoring studies that have occurred.

Utility bills will provide the amount of energy consumed and the cost per billing period. Generally, the utility bills are for the entire facility including areas other than food service.

Energy submetering records can be used if available. In this case, food service energy is metered separately and could be reviewed on a daily basis.

Equipment energy specifications would be found on equipment inventory records, catalogs, or from the specification name plate on the equipment. Contact equipment representatives for assistance in locating energy specifications of older equipment.

Customer meal count is the daily number of people eating a meal. These records for the energy monitoring period will provide values to determine the amount of energy it takes to produce and serve a customer meal.

Energy Consumption Base

To measure the effectiveness of an energy conservation program, you need to establish a base for energy consumption -- the energy used for the past twelve months. The energy consumption during the base period, when compared with current use, will provide you with the opportunity to monitor the effectiveness of your energy conservation program.

Follow these steps to establish your energy consumption base:

(1) Assemble utility bills for the base period identified. Sort them by month. If your bills are incomplete, call the utility company or energy suppliers and have them send past records.

(2) Complete the Monthly Worksheet for Energy Consumption Base (Sample Forms section, pages 44-47):

a. Enter the amount and cost of different types of fuel purchased during each month of the base period. Be sure to read the consumption correction. For example, if your natural gas use is indicated with a CCF, then you need to add two zeros to the figure shown on the bill, because 1 CCF=100 cubic feet. Convert cubic feet to therms by multiplying CF by 1.022. Do not include demand charges in British Thermal Units (BTU) figures, only in cost.

b. Convert all different types of fuel consumed to BTUs and total your consumption and costs for the month.

(3) Complete the Base Year Audit Form Annual Worksheet (Sample Forms section, page 48).

a. Enter the monthly consumption and cost totals on columns 2 and 3 of the Base Year Audit Form Annual Worksheet.

b. The next piece of important information you will need is your customer count--the number of persons served during each month. Go back in your records to the base period and enter the number of meals served in column 4 of your Base Year Audit Form Annual Worksheet for each of the 12 months (or 10 months) in the base period. This will allow you to determine energy used per customer. All meals are not equivalent; therefore, you need a standard method for determining meal equivalents that you use each time you do these calculations. Use the following meal equivalents:

1 reimbursable meal	=	1 meal
2 reimbursable breakfasts	=	1 meal
total dollars of other sales ÷ cost of reimbursable meal	=	1 meal

Your total energy use may go up in the future, but if your customer count is going up at a faster rate, your energy use per customer will go down--you will have verified the effectiveness of your program.

c. Divide the total energy use for the month (column 2) by the customer or meal count (column 4) and enter in column 5. This is the energy used per customer for that month.

d. Divide the total energy use for the month (column 2) by the number of square feet in your school food service operation and enter in column 6.

The Monthly Energy Audit

Once you have completed the base year information, you are ready to spend approximately an hour per month tracking energy use and comparing each month's information with the base year. After you start the energy conservation program, monthly charts will provide a visual assessment of progress.

Twelve copies of the Monthly Worksheets for the Current Year (Sample Forms section, pages 49-52) are provided for your convenience. They will take you through the first year of your energy conservation program.

Electrical Demand

Electric utility companies generally charge for peak electrical demand. Peak demand is the maximum electrical capacity required to serve a facility at any time. It is based on the electrical generation and distribution equipment needed to provide the power required when your greatest demand occurs. If, for example, the greatest demand occurs between 9:30 am and 10:00 am on a heavy production day, the charge for the billing period will be based on that peak demand.

ATTENTION! *Scheduling equipment throughout the day rather than during one short period will reduce peak demand charges.*

Figure 1 shows a comparison of two companies that use the same total energy, but have scheduled production differently. The company with demand control will pay less to the electric company.

In food service, the peak times of energy use occur when producing hot food menu items. Ovens, steam kettles, and other electric equipment consume large amounts of energy. To reduce electricity demand, review and modify the menu, develop production schedules, and conduct routine equipment maintenance.

Menu management generates all other functions in the food service. Review menu items for preparation energy requirements and production time needed. Review equipment to determine if it is being scheduled and maintained for efficiency. These steps will reduce energy demand.

Energy Audits

Observation and audit records will serve as the basis for determining conservation opportunities throughout the food service facility or system. The goals of these activities are to observe first and then to record facts in order to evaluate the information for conservation. The school food service manager, responsible for controlling energy usage, also must evaluate the total operating system for food quality and safety. The observation and audit records provide a starting point for energy and operational decisions.

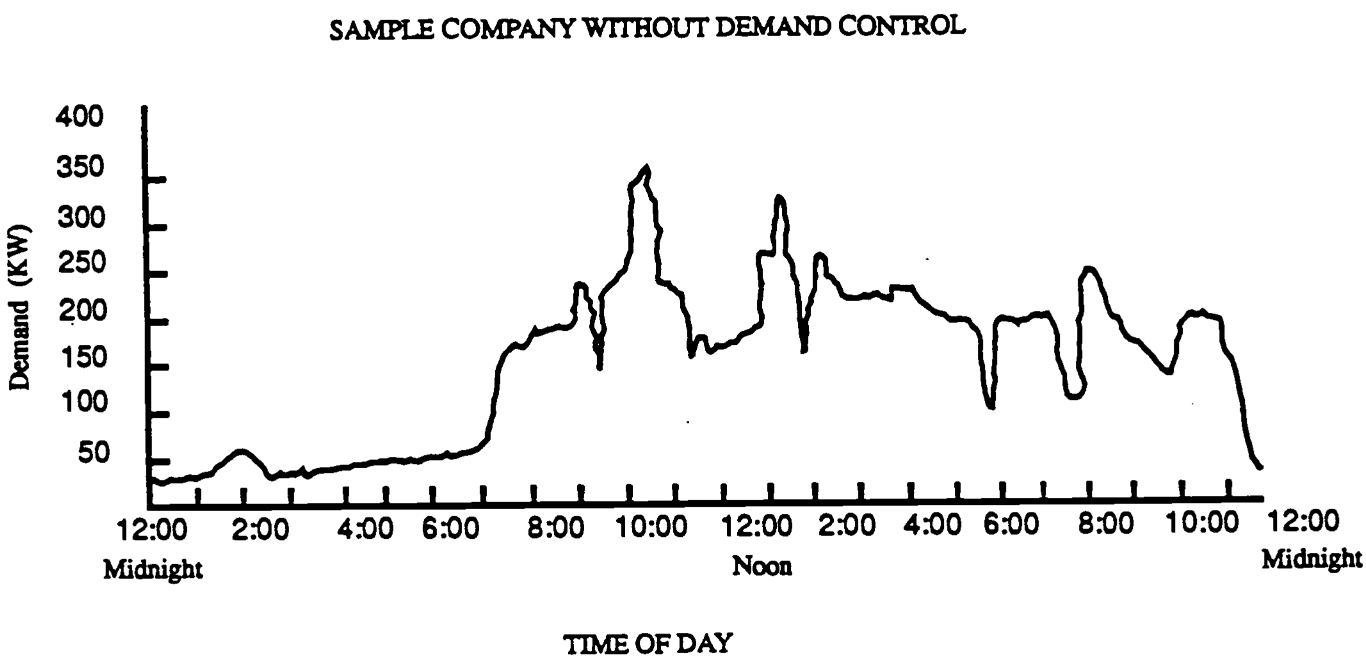
Steps in the Energy Audit

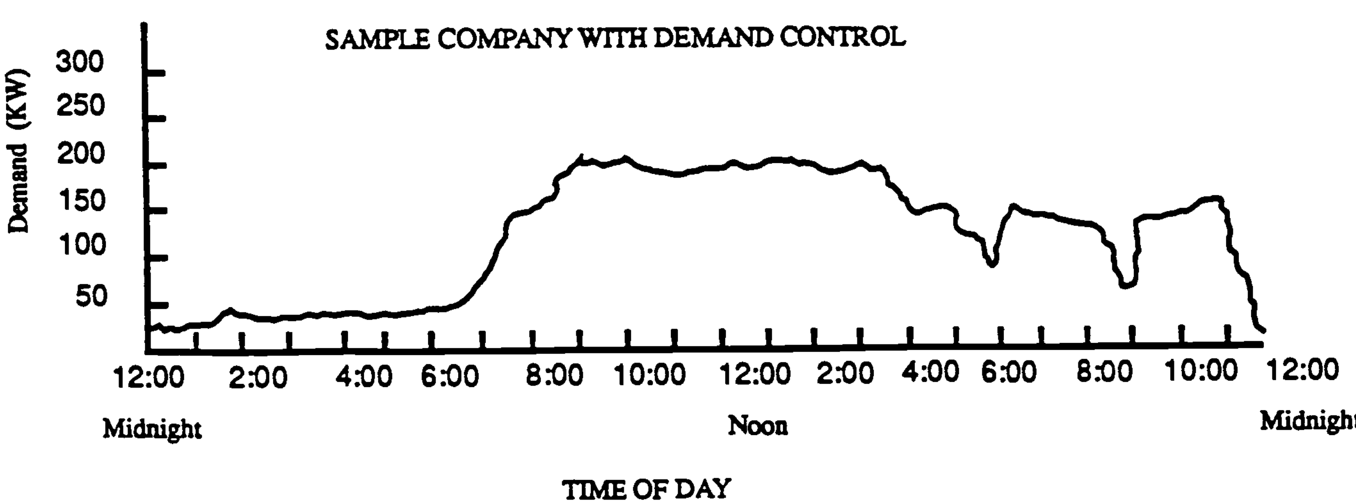
An energy audit is a methodical examination and review of energy use and conservation opportunities. The audit includes both qualitative (conceptual) and quantitative (measurable) observations of energy use in the food service operation. The energy audit is a necessary step in any conservation program because it reveals gaps in current management of energy, gaps which once recognized can save money for more efficient program development. To perform an energy audit, the following procedures should be followed.

First, the manager should review the section on Energy Conservation and Improvement to get ideas of what to observe. Tables 1 and 2 (pages 28-32) are particularly helpful.

Second, conduct a "walk through", observing and listing all energy-using equipment, operating procedures, and environmental control (heat, light, security systems). Each Energy Planning Team member should perform the observation review individually; then when the team meets the summary of each review should provide a complete listing of energy-using equipment or environmental control for all areas of the food service. An example of an Energy Observation Record is shown in Figure 2.

Figure 1. Demand Comparisons.





Source: Wheeler, G. (1980). *Energy Conservation Manual for the Oregon Food Service Industry.* Corvallis, OR: Oregon State University Extension Service.

Figure 2. Energy Observation Record (An Excerpt)

ENERGY OBSERVATION RECORD

Observer________________________ Date________________

Please record energy-using equipment by area.

Area	Energy-using Equipment and Environment	Comments
Receiving	Hydraulic dock motor	
	Electric tugs	
	Can crusher	
	Box baler	
	Lights on dock (outside)	
	Bug fans	
	Lights in receiving area	

In general, the food service areas/functions to be included are:

Receiving	Preparation
Dry Storage	Vegetable
Chemical Storage	Meat Slicing
Freezer Storage	Hot Food
Refrigerator Storage	Salads/Sandwich
Ingredient Room	Bakery/Desserts
Assembly	Compressor Room
Distribution/Service	Boiler Room
Cartwashing	Lighting
Warewashing	Ventilation
Dishwashing	Other

Within each food service area there are numerous opportunities for energy conservation. For example, if ovens are not fully loaded when in use, an operational change may be to replan production so that ovens can be on less hours and run at full capacity. For each piece of energy-using equipment, ask yourself, "Do I need this?" and "Can the same results be achieved more efficiently?" In answer to these questions, some managers, for example, have eliminated preheat times for ovens, others have changed the type of metering and obtained lower electricity rates.

Third, compile an Audit Record Form (Figure 3) based on the "walk through" to be used for future audits of the food service. The food service manager should compile the Audit Record Form based on the details provided on the Energy Observation Records (Figure 2) and the team meeting discussion. The Audit Record Form should be used for both the initial step as well as in periodic energy audits. Audit Record Forms should be developed for each food service system to facilitate the tasks of the team members.

Methods for Identifying Energy Use

The goal is to conserve energy in the food service operation. The concept of conservation is excellent, but managers must know how much energy was used in order to determine if conservation efforts are effective. Managers must identify the type and amount of energy used before planning for conservation. There are three techniques that can be used: (1) read your utility meter, (2) keep a record of equipment use by attaching a monitor to the equipment, or (3) keep an energy record.

Utility meter reading

To determine daily energy use the ideal method is to study the utility meter records. Instructions on how to read a meter are included in the Technical Information section of this manual. However, in most schools the utility meter reading is not just for food service but for the entire school. The meter reading, therefore, includes energy used for building heating and air conditioning and lights for classrooms, library, restrooms, recreation areas, and other building areas. If this is the case in your school, then investigate the possibility of having a sub-meter installed by the power company which

Figure 3. Audit Record Form (An Excerpt)

AUDIT RECORD FORM

Recorder______________________________ Date__________________

AREA	EQUIPMENT	COMMENTS	ACTION			
			Repair	Replace	No Change	Change Operation
Receiving	Hydraulic dock				x	
	Platform				x	
	Doors				x	
	Lights				x	
	Electric tugs	Plugged in 8 hours instead of 4 hours	x			
	Can crusher				x	
	Box baler				x	
	Outside door	Cold air leak	x			
	Lights on dock	Excessive number		x		
	Bug lights	Not working	x			
Refrigera-tor	#1 Dairy	Door gasket split on side	x			
	#2 Veg/Fruit	Door stands open				x
	#3 Grain, flour, misc.	Air curtain unavailable		x		

would specify energy usage only for the food service area. Based on these actual food service energy use meter records, energy conservation decisions then can be made. The physical plant engineer/supervisor and utility company representative can coordinate these efforts. If the food service facility does not have separate utility meters, a review of energy consuming equipment is an alternative. This method of measurement is the basis of the other two techniques.

Equipment Monitoring

The second technique is to buy, lease, or rent energy monitoring equipment. Attach the monitors to selected pieces of food service equipment to measure individual equipment energy use. This is not an economical method if all equipment is to be studied in the same time period. It is more useful if each piece of equipment is studied individually and the consumption is added together to provide an estimate of total energy used.

Energy Record

A third method of measuring energy use can be utilized, when sub-metering or individual equipment monitoring is not possible. This method is to manually calculate the energy by multiplying the equipment rating by the actual time the equipment is operating. An equipment rating is determined from the equipment specifications, which include the kilowatts (kW), volts (v), amperage (amps), phases (p) or BTUs (see equations on page 42).

Energy specifications and equipment identification information is often (but not always) listed on the "name plate" that is attached to the equipment. If any of the information is missing, four other sources could provide the information:

(1) Equipment inventory record
(2) Equipment operating manuals
(3) Distributor
(4) Manufacturer's equipment catalogs

Older equipment may no longer be listed in a catalog. The next best thing is to make an estimate of the specification from a similar piece of equipment for which there are records. If no records exist refer to the BTU Rating List, included in the Technical Information section of this manual, which provides general estimates of energy use for various pieces of food service equipment.

Once you have completed the work of gathering equipment specifications, that information should then be maintained in a computer or manual file. Be sure to include the equipment name, manufacturer, model, and serial numbers. Examples of Equipment Records are shown in Figures 4 and 6-9. Figure 5 illustrates an Equipment Maintenance Record, which should be maintained for each piece of equipment. The Equipment Maintenance Record could be kept on the back of the Equipment Record if a manual card file is maintained.

Figure 4. Equipment record (front of card) displaying energy specifications for a gas oven.

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EQUIPMENT RECORD

School: Portland

Site: Buckman

Equipment: Oven

Brand: Wolf

Serial #: 60254

Model #: 0-26-3H

Site ID: 029950

kW ______ Volts ______

HP ______ Amps ______

BTU/HR 35,000 Phase ______

Duty Cycle .30

Notes: ______

Figure 5. Equipment Maintenance Record (back of equipment record card).

EQUIPMENT MAINTENANCE RECORD

Date	Maintenance Performed	Parts Replaced	Completed By

Figure 6. Equipment record displaying energy specifications for an electric dishwasher.

EQUIPMENT RECORD

School:	Dallas	kW	1.62	Volts	208
Site:	Lyle			Amps	7.8
Equipment:	Dishwasher	HP	1	Phase	1
Brand:	Hobart				
Serial #:	B430880	BTU/HR			
Model #:	AM12A	Duty Cycle	.30		
Site ID:	1959				
Notes:					

Figure 7. Equipment record displaying energy specifications for steam. Information is for a convection steamer which also uses electricity for a fan.

EQUIPMENT RECORD

School:	Fairview Training Center	kW	0.58	Volts	115
Site:	Base Kitchen			Amps	5
Equipment:	Conv. Steamer	HP		Phase	1
Brand:	Cleveland				
Serial #:	2168221	BTU/HR			
Model #:	X22DS	Duty Cycle	.25		
Site ID:	F07626				
Notes:	35 PSI/1000 lb/hr (steam)				

Figure 8. Equipment record displaying energy specifications for a gas convection oven with an electric fan.

EQUIPMENT RECORD

School:	Portland	kW	1.31	Volts	115
Site:	Buckman			Amps	11.4
Equipment:	Convection Oven	HP	.75	Phase	1
Brand:	Montague				
Serial #:	89C8052	BTU/HR	115,000		
Model #:	2115X4G	Duty Cycle	.30		
Site ID:	029948				
Notes:					

Figure 9. Equipment record displaying energy specifications for an electric mixer that does not cycle. 33

EQUIPMENT RECORD

School: Fairview Training Center	kW 0.94	Volts 115
Site: Base Kitchen		Amps 8.2
Equipment: Mixer	HP .33	Phase 1
Brand: Hobart		
Serial #: 1710748	BTU/HR ______	
Model #: A200D	Duty Cycle ______	
Site ID: ML 17280		
Notes: 35 PSI/1000 lb/hr (steam)		

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Tracking Energy Use

Once the equipment BTU ratings have been determined, the manager should select a three to five day test period during which employees will record equipment operation. An Equipment Usage Log, such as the one in Figure 10, can be used. A blank copy of the Equipment Usage Log Form is provided in the Sample Forms section of this manual. Employees should be instructed to record every action performed on every piece of equipment throughout the work period. Each piece of equipment should have an individual form containing all the information attached in an easily visible spot. For example, if an oven is turned on to 350° F at 7:00 am, and then changed to 375° F at 9:00 am, the employee should note these under the time, on/off, and temperature columns. All changes during the day should be noted.

The record keeping should be accurate and consistent throughout the specified period in order for the results to be valid. The manager should periodically check to see that this is being done. Once the day is over, each piece of equipment then can be analyzed for energy use by adding up the total time it operated, and multiplying that by the equipment rating. The manager should be sure to account for equipment cycling when doing these calculations. This is discussed in more detail on page 20. Adding the energy consumption of each piece of equipment together will give the daily total. See an example of the calculation in Figure 11.

Analysis of Energy Use

Meter readings and equipment use records provide the data needed to determine how much energy is used during a school food service day. Several days can be evaluated and an average can be calculated which represents energy use per day. In addition to energy use, demographic data should be collected including: (1) meal census, (2) production schedules, and (3) menus.

The amount of energy calculated for the day divided by the number of meals served is the average amount of energy it takes to prepare a meal. This value will be greater if the total building meter reading is used for the energy calculation as it will include lights, heating, and air conditioning. If equipment usage records are studied, energy use will be smaller as the heat, air, and lighting will not be included. Either method is acceptable as long as there is consistency from one time to the next. In both cases, the information will serve as a guideline in making energy conservation decisions.

Energy Use Calculations

Very often, kW ratings will not be noted directly on the equipment plates, but other data can be used to determine it. Some simple calculations will have to be performed to obtain the information. The following equations can be used for doing these calculations.

Figure 10. Equipment Usage Log

EQUIPMENT USAGE LOG

SCHOOL Dallas SITE Oakdale

EQUIPMENT oven BRAND Wolf

SERIAL # 01734 MODEL # 2762

SITE ID 11271 RPM

kW 24 VOLTS 120 AMPS 20 PHASE 1

HP BTU/HR

TIME	ON/OFF	TEMPERATURE	COMMENTS
7:00 am	on	350°	preheat
7:45			add cinnamon rolls
8:00			remove rolls
9:00		375°	add chicken patties
9:30			add chicken patties
10:00			add chicken patties
10:30	off		remove patties

Figure 11. Daily Energy Consumption Record excerpt to document total daily energy used by equipment.

DAILY ENERGY CONSUMPTION RECORD

Equipment	ID#	Rating KW	Rating BTU/hr	Rating Steam	Total Minutes Operating	Total Energy Consumption	Energy in BTUs (kWh x 3413)
Oven	27056		118,000		3 hours	354,000 BTU	354,000
Mixer	27078	1.2			10 minutes	.2 KWH	683
Blender	28432	.9			5 minutes	.07 KWH	283
Warmer	27634	5.1			4 hours	20.4 KWH	69,625
GRAND TOTAL							424,542

Electric Power

Power is recorded in kilowatts (kW). To determine the number of kilowatts used, the equations are:

(Equation 1 for heating elements)

$$kW = V \times A \times \sqrt{P}$$

where: V = volts
A = Amps
P = number of phases (1 or 3)
$\sqrt{}$ = square root
kW = kilowatts

(Equation 2 for motors)

$$kW = HP \times 0.746/\text{motor efficiency}$$

where: HP = horse power
efficiency = ratio of motor output to input power[1]

- or -

(Equation 3 for motors)

$$kW = V \times A \times \sqrt{P} \times PF$$

where: PF = power factor[2]

Duty Cycle

Some equipment (such as an oven) may not run continuously although it is still turned on. Once the proper temperature is reached, the internal thermostat will temporarily shut off to avoid overheating. Energy is not used by the equipment during this time. The amount of time the equipment actually operates divided by the total time it is turned on is known as the duty cycle (DC). The DC can be calculated using equation 4.

(Equation 4)

$$\text{Duty Cycle} = \frac{\text{Time operating}}{\text{Time On}}$$

Electric Energy

Once the kW rating of the equipment and the operating time are determined using the equations above, the next step is calculating energy use. Energy use is measured in kilowatt hours (kWh). Energy is the amount of power multiplied by the amount of time the equipment is operating (Equation 5).

---

[1]If motor efficiency is not known, use 0.80 for small motors

[2]If no power factor is available, use 0.75 for small motors

(Equation 5) kWh = kW x time x DC
where: kWh = kilowatt hours
DC = duty cycle

For example, a 12 kilowatt (kW) oven that operates for 2 hours with a duty cycle of .30 has used 8 kWh.

Conversions to BTU

Fuel use is measured in different units for gas, electricity, and steam, and many school food service facilities will use a combination of two or three types. They all must be converted to a common unit before a valid comparison can be made. The British Thermal Unit (BTU) is the common unit to which all energy can be converted.

The measurement of energy requires that all gas, electricity, and steam use be converted to BTU. The following equations can be used in converting units to BTU.

(Equation 6)	kW x 3413	= BTU/hour
(Equation 7)	HP x 2546	= BTU/hour
(Equation 8)	BHP x 33,500	= BTU/hour
	where: BHP = Boiler horsepower	

Graphing Energy Usage

Total energy consumption should be calculated for each piece of food service equipment daily and the results plotted on a graph. These values represent only equipment usage, including refrigeration and compressor, for the food service day. An example is shown in Figure 12 where energy consumption in kWh is plotted over time.

The school food service manager also should put utility meter readings on a graph to illustrate building energy use or sub-metered food service use. Building energy use should show some of the same "peaks and valleys" (highs and lows) in the usage as does the equipment data. If food service is sub-metered, total energy use minus food service equipment usage will give the amount of energy that was consumed by lighting, heating, and air conditioning in the food service areas.

These data provide a baseline of energy used in preparing school meals. However, further inspection of the data will reflect peaks and valleys of equipment usage and the corresponding meal items that were prepared. Also, excessive "on" times for equipment such as ovens or ventilation hoods when no food was being prepared will be observable when comparing energy usage graphs with menu and production scheduling. These production analyses will alert the manager to the need to study the entire operation further as it affects energy usage and conservation. Figure 13 provides examples of energy use graphs.

Figure 12. Graph of food service energy use as calculated from Energy Usage Log.

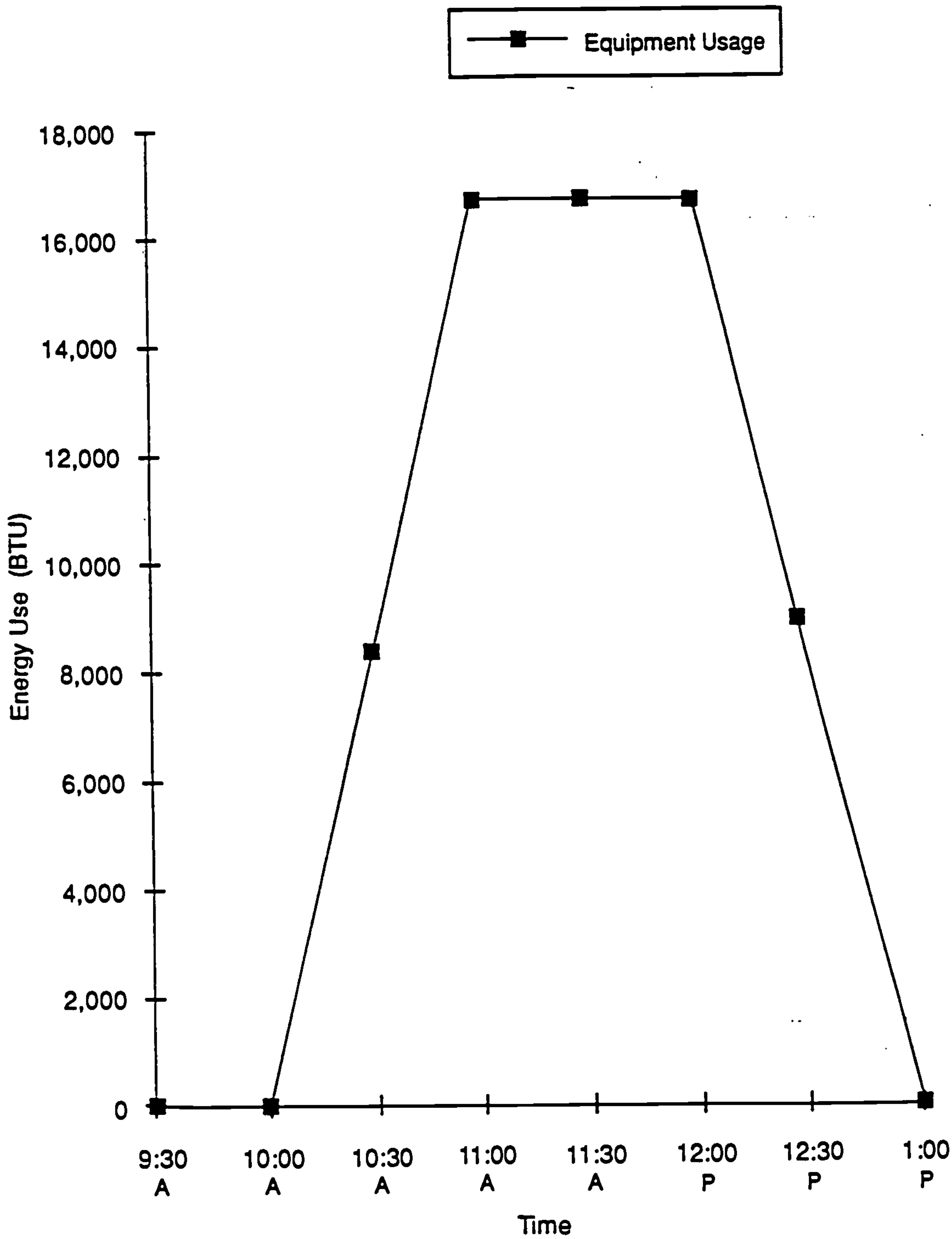
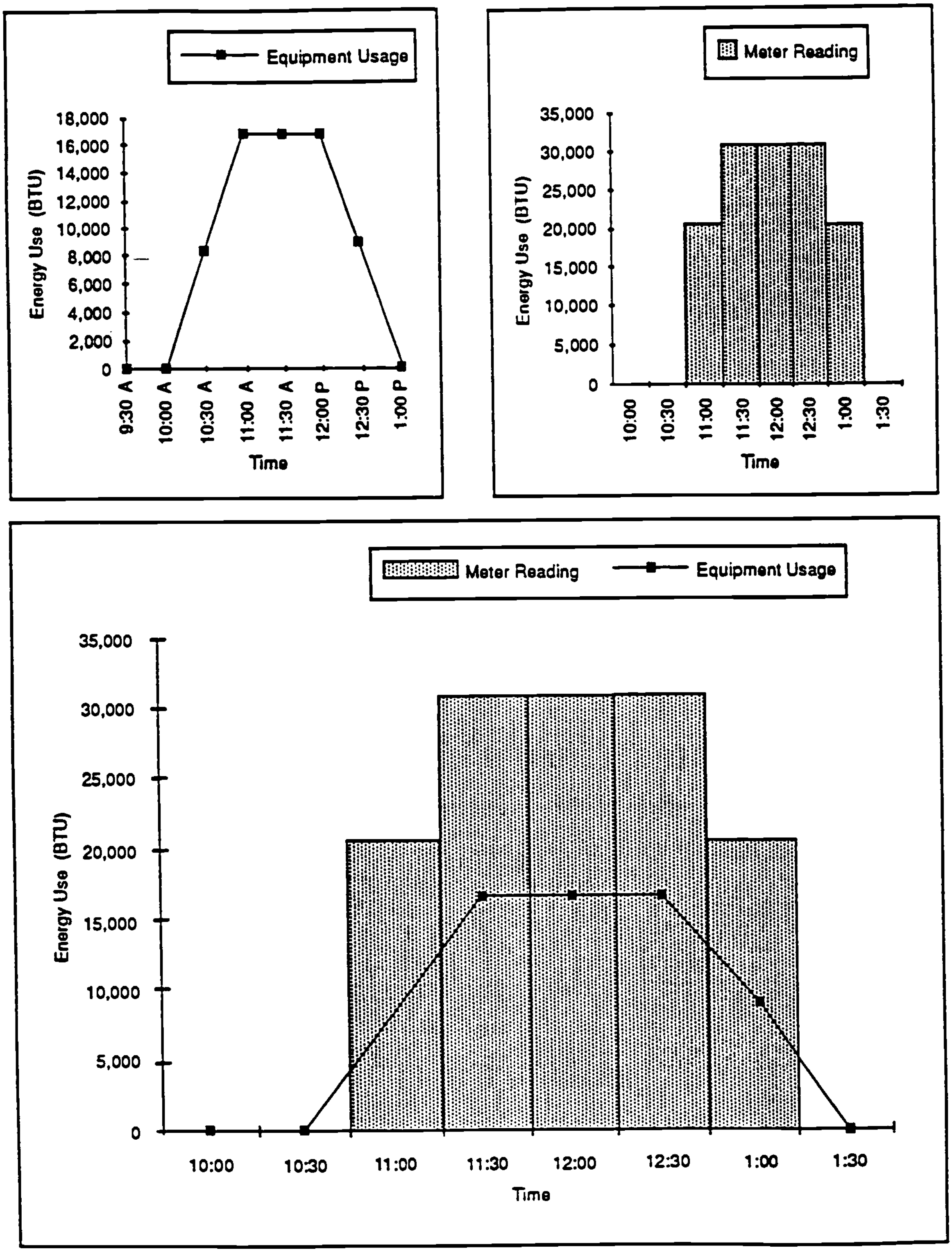


Figure 13. Daily energy use: Equipment usage, meter reading, and combined.



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The most direct way to review energy use is to plot energy use against time of day. This can be done as two graphs: (1) Equipment Usage (Figure 13) and (2) Meter Reading (Figure 13). The two graphs can be overlaid into a combined graph (Figure 13). The figures reflect total gas or electric building metered energy usage and the food service equipment energy use as measured from the Equipment Usage Logs. Visual examination identifies food service energy use in relation to total building which includes heat, lights, and ventilation, as well as general equipment, such as projectors, video/recording equipment, employee coffee lounges, and hot water. The analysis will provide the food service manager and teams with an indication of the percent of energy used by food service in relation to the total building usage. After energy conservation techniques have been implemented, a second review of the use comparison can be made that will reflect a reduction in food service energy use.

Energy Use per Meal

This review should be taken a step further. The amount of energy required to prepare and serve a meal based on equipment usage should be calculated from daily energy records using the Energy Use Per Meal Record (Figure 14). For purposes of comparing the energy use per meal over time, you will need to determine the number of meal equivalents that you serve. The method for calculating meal equivalents is explained on page 4.

ATTENTION! *Total BTUs divided by the number of meals served is the calculated energy use per meal.*

This record can be used to highlight variations in energy use and compare them to the menu. In the example below, the meal prepared on September 13 included more hot menu items compared to the meal on September 11, when cold sandwiches were served. This information can serve as a "bench mark" or record of usage. These values can be used to compare energy usage after conservation measures have been implemented.

Figure 14: Energy use per meal recorded in British Thermal Units (BTUs)

ENERGY USE PER MEAL RECORD

School ______________________ Year ______________

	DATES					
	Sept 11	Sept 12	Sept 13	Sept 14	Sept 15	5-Day Average
Total Energy Use (BTU)	333,282	362,167	341,548	363,203	347,251	349,490
No. Meals Prepared/Served	254	248	200	237	242	236
Average Energy (BTU) per Meal	1,312	1,460	1,708	1,532	1,435	1,489

An example of a document showing the tabulation of the total BTUs per meal used by food service equipment in a school using a conventional food production system was shown in Figure 11. A conventional food production system is one in which the food is purchased at various stages of preparation for an individual operation, and where production, distribution, and service are completed on the same premises. Following production, food is held hot or refrigerated, as appropriate for the menu item, and served as soon as possible.[3] See Glossary/Equation section (pages 40-41) for descriptions of other food service production systems: Commissary, Ready Prepared, Assembly/Serve, Cook-Chill.

Note of Caution

In calculating energy use, here are some problems that may typically occur:

- Equipment name plates missing.
- The exact duty cycle for each piece of equipment can not be determined.
- Employees "forget" to record the equipment use data.
- Physical plant engineers might need to unlock compressor rooms.
- Utility company representatives may appear on the wrong day.
- Major equipment not scheduled for use on a "test day".
- Submetering may be possible, but the physical plant representative could unplug the equipment too soon or not "store" the data and all is lost.
- Building utility meter may have a locked cover.

Awareness of these mishaps can help to guard against them in your studies.

[3]Spears, M.C. (1991). *Foodservice Organizations: A Managerial and Systems Approach* (2nd ed.) New York: Macmillan Publishing Co.

ENERGY CONSERVATION AND IMPROVEMENT

There are two levels of energy conservation and improvement that will be presented: (1) nontechnical and low cost enhancements, and (2) capital investment and systems change.

Non-Technical and Low Cost Enhancements

Nontechnical and low cost enhancements focus on operational changes that can be implemented immediately with little or no cost. These enhancements, however, do often require a great involvement of human resources. Periodic training for current employees and more comprehensive training for new employees on energy conservation methods such as turning off lights or eliminating oven preheating for some menu items, will result in significant cost savings. Other conservation measures are to maintain equipment for maximum efficiency and to plan menus for energy efficiency.

Training topics for food service personnel should be generated from the results of audit reports of the Energy Operational Team. Training should include general energy concepts, observation methods, efficient use of equipment, routine cleaning, and inspection as a part of the maintenance program. Energy efficiency should be an important part of menu planning and production scheduling. These concepts allow food service personnel to understand the energy impact when making menu and production decisions.

Equipment maintenance is important in food service. Clean, well-maintained equipment can enhance energy conservation and completion of scheduled work. A preventive maintenance schedule should be developed with maintenance and engineering personnel. The schedule should be planned to follow both the manufacturer's suggested schedule and the use of equipment.

Preventive maintenance is not totally up to the maintenance department; it is also the responsibility of food service personnel. Food service personnel must keep equipment clean, and observe cracks, wear, and loose parts and listen for malfunctions and odd sounds which are indicators of a problem. Maintenance personnel on a regular basis should observe, oil, grease, sharpen, replace worn parts, and, in general, keep the equipment operating. Preventive maintenance reduces production costs and conserves energy by planning "down" time when equipment needs work such as replacing thermostats, lights, belts, and heating/cooking elements.

Menu design and management are very important. Try to include a balance of acceptable menu items that will conserve energy. The menu planner must know the equipment and its capacity. Planning should consider the equipment energy use and labor productivity. A balance of cold and hot menu items will proportion energy use and avoid peak demands as generated by some menus. For example, choosing a cold entree salad as a selection with pizza will reduce the oven usage compared with chicken nuggets offered with pizza.

A nontechnical and low cost conservation checklist, including rationale, may be found in Table 1. The school food service manager can implement energy improvement by following these suggested conservation actions. This level of conservation requires some adjustment in the operating budget. The decision for energy conservation may require reprioritizing other resource expenditures.

Capital Investment and Systems Change

Major energy efficiency improvements require a capital budget plan in an existing food service operation. Should a building plan be considered, these systems should be planned into the design. Food service facilities often are located in older buildings that have not been remodeled to enhance the food service and energy usage. The system change conservation actions take budget and construction planning over a period of time. Table 2 summarizes energy conservation practices that require capital investment and systems change. When planning for renovation, always review energy usage and conservation as a part of the plan. The school food service manager and energy teams should be actively involved in planning for any capital investment or system change projects.

Investment Decisions[4]

There are numerous energy conservation opportunities that can be realized at little or no cost. Implement all of the minor cost opportunities that are consistent with your objectives.

The manager will probably find a number of energy saving opportunities that involve a financial investment. These must be analyzed carefully to determine if the payback in energy savings (and dollars) will justify the investment.

An investment in energy saving equipment, remodeling, or other energy-saving devices may be analyzed by looking at the expected payback period. A second, and more refined method of analyzing an energy-related investment, is life-cycle cost. This approach takes into account increasing energy costs, as well as the desired return rate on the investment. Both of these methods are explained briefly on the next few pages.

<u>Payback Period</u>

For equipment that will have a limited life it is useful to look at how long it will take the investment to pay for itself through increased net profits. To determine this, the manager needs to know the cost of the equipment or improvement, the expected life of the equipment, and the estimated annual net profit that would result from the investment. As long as the investment will be repaid through increased profits during the expected useful life of the equipment, the investment is a sound one. For example, consider the purchase of a new, more energy efficient water heater for $500. Assume that the anticipated saving in energy costs is $100 per year. With a five-year payback period, this would be considered a good investment. However, there may be better investments with shorter paybacks competing for the same capital.

[4]Wheeler, G. (ed.) (1980). *Energy Conservation Manual: Oregon Food Service Industry*. Oregon State University Extension Service, Corvallis, OR.

Table 1. Nontechnical and Low Cost Enhancement Conservation Check List and Rationale.

Have Done	Will Do	Conservation Action	Rationale
		PLANNING AND SCHEDULING	
		Plan menus to include energy conservation.	A balance of high and low energy consuming equipment will reduce energy demand.
		Operate the equipment at full capacity.	Maximum product to be cooked with the energy used.
		Schedule the preparation and production of menu items to distribute energy use.	Staggering energy consuming equipment use will decrease the total demand at any one time.
		Sub meter the food service to determine energy use.	Provides accurate usage data for energy calculations and conservation records.
		OVENS, STEAMERS, RANGES	
		Do not preheat oven equipment unnecessarily when baking and roasting menu items, i.e., meat loaves, roasts, turkeys, and other large meat items and many breads, cookies, and cakes.	Menu item quality is achieved without preheating the oven with an energy saving of 10-14%.
		Use minimum preheating times for all equipment if preheating is necessary.	Test the food service equipment to determine the preheating time for it to reach expected temperature. Newer equipment will have a short preheat time.
		Schedule nonfood cooking equipment to operate at non cooking time, i.e., refrigerator and freezer defrost to operate "after hours".	The facility engineer can assist in establishing times for nonfood production equipment to operate.
		Establish a cleaning and preventive maintenance schedule for all equipment.	Schedule to clean and maintain equipment at non production hours. This will prevent delays in production and stress of the food service personnel.
		Turn off equipment when it is not in use. (Do not turn on all equipment at the beginning of the work schedule.)	Reduce energy use and peak demand.
		Cook food at the lowest safe temperature that will give satisfactory results.	Lower temperatures use less energy.
		Thaw frozen food in refrigerators unless product characteristics prohibit it.	Less cooking time will be required for thawed food and the refrigerated space will require less energy.

Table 1 (cont).

Have Done	Will Do	Conservation Action	Rationale
		Adjust gas equipment burners until the flame is entirely blue with a firm center cone.	Routine maintenance of gas equipment will help maintain efficient use of gas.
		Recalibrate thermostats on cooking equipment at least once a year. A technical person can be contracted to do this.	To maintain even temperature cooking without excess consumption of energy.
		Load and unload ovens quickly to avoid unnecessary heat loss.	For every second an oven door is open, oven temperatures will drop by approximately 10° F.
		Use lids instead of aluminum foil over products baking or roasting in the oven.	Aluminum foil reduces oven effectiveness and increases the cooking time.
		Schedule microwave and convection ovens at peak demand periods if possible.	Microwave and convection ovens use less energy.
		Turn the steam off for steam kettles when not in use.	Reduces unnecessary heat loss from kettles and steam lines, preheat times are short.
		Plan to use steam cooking as much as possible.	Steam cooking uses less energy because steam transfers heat to food readily.
		Turn off ventilating hood fans over cooking equipment when equipment is not in use.	Hood ventilating systems consume energy needlessly if cooking is not scheduled.
		Group pots and kettles close together on range tops.	Consolidates heat and allows unused sections to be turned off.
		Reduce heat on range as soon as the contents begin to boil.	Lower heat will maintain the cooking temperature (once food boils, excess is lost to the environment).
		Cover pots and kettles with lids.	Retains heat and shortens the cooking time.
		Replace pans if the flat bottoms are no longer flat.	Requires more heat and longer time for range top cooking.
		REFRIGERATION/FREEZERS	
		Allow hot foods to cool to 140° F before refrigerating or freezing them, except bread and cake items can cool to a lower temperature.	Extremely hot foods will place an extra demand on the cooling units.
		Place cold or frozen food in temperature controlled storage immediately upon delivery.	Eliminates recooling or freezing warmed food which uses extra energy and maintains food quality.

Table 1 (cont).

Have Done	Will Do	Conservation Action	Rationale
		Do not store empty mobile racks in refrigerators or freezers.	Save the energy it takes to cool them.
		Consolidate refrigerated and frozen foods where possible. Shut down refrigerators and freezers if not needed.	Full refrigerators and freezers use energy more efficiently.
		Avoid frequent, long opening of freezer and refrigerator doors.	Heat enters the unit causing energy use to increase.
		Check temperatures on all refrigerated and freezer units.	A check on the operation of the unit and to ensure temperature safety levels.
		Store or pack food to allow air to circulate freely around the food items. Don't block vents.	Maximizes the cooling process.
		Arrange and label food items in the refrigerator or freezer in an orderly system to allow easy and quick placement and removal of food item.	Reduces the time that the door will be open and/or a person is in the refrigerator or freezer.
		Maintain the condenser coils so that they are free of grease and dust.	About once a month, vacuum and remove grease with hot soapy water from coils to maximize energy efficiency.
		Defrost to keep the evaporator free of frost. Set defrost schedule for after peak production hours and defrost for a minimum time to achieve complete defrost.	Frosted/iced evaporator unit will use excess energy to maintain operation.
		Reset defrost time clock (and other time clocks) regularly and after power outages.	Correct timing will better achieve desired results and save energy.
		Compressor should be checked periodically for loss of refrigerant.	Maintain refrigerant levels to maximize efficiency.
		Install "strip curtains" in the entrances of refrigerators and freezers.	Reduces warm air entering when the doors are open.
		Replace cracked or torn door gaskets on all refrigerator and freezer doors.	Reduces the amount of air leakage and conserves energy.
		DISH AND WAREWASHING	
		Use warm or cold water if possible when scraping dishes prior to the wash process.	Hot water uses more energy.
		Do not heat rinse water above 190° F.	Temperatures above 190° F increase evaporation and use more energy.

Table 1 (cont).

Have Done	Will Do	Conservation Action	Rationale
		Add pressure regulator to adjust water pressure if needed. (Contact a technician.)	Dishes don't wash and rinse well with low pressure and water will be wasted with high pressure.
		Turn off the machine and pumps when not in use.	Conserves energy.
		Check water temperatures.	Excessive temperature wastes energy. Thermostats may need to be adjusted.
		Clean rinse arms and nozzles daily.	Dishes will get clean and require less energy use.
		Wash only full racks of dishes.	Uses energy and time effectively.
		Install a wetting agent in the dishwasher.	Eliminates the need for power drying on china dishes and glassware.
		HOT WATER	
		Do not leave faucets running.	Saves water and energy.
		Use cold or warm water whenever possible.	Conserves energy by reducing hot water use.
		Repair leaky faucets.	Saves water and energy.
		Locate the hot water booster heater as close to the dishwasher as possible or insulate pipes.	Eliminates loss of heat being delivered to the dishmachine.
		LIGHTING	
		Rewire lights to multiple switching for different lighting levels and for separate areas.	Allows partial lighting when full lighting is not required.
		Install dimming controls for spaces requiring more than one light level such as dining rooms.	Lights can be dimmed which reduces energy yet maintains security.
		Rewire ventilation hood lamps to operate separately from the fan.	Some lights and fans are on the same switch. The fans are left on just to provide light.

Table 2. Capital Investment and Systems Change.

Have Done	Will Do	Conservation Action	Rationale
		Replace older energy consuming equipment with new energy efficient equipment, such as ovens, dishwashers, and ranges.	Conservation of energy preheat times and operating efficiency.
		Replace obsolete equipment with energy efficient equipment.	Conserves energy by reducing operating time and energy use.
		Consider the use of "reach in" refrigerators in the work areas to reduce the use of "walk in" refrigerator.	Smaller doors and quicker access to the food items. Reduces warm air flow into the refrigerator and conserves energy.
		Install an air curtain at high use entrances with interlocking switch to activate air curtain only when the door is open.	Minimizes the use of the air curtain yet maintains air temperature at entrances.
		Install heat recovery equipment on refrigeration equipment, incinerators, hot waste water, and exhaust air to heat hot water.	Reduces energy needed to heat hot water.
		Replace standard kitchen hood with heat recovery hood.	Reduces energy to heat make-up air.
		Replace standing pilot lights on gas equipment with electronic ignition.	Gas is used only when needed.
		Install trash compactors and shredders.	Food and paper waste can be recycled by burning as fuel for building heat. Check local codes and equipment manufacturers.
		Consider other food production systems such as commissary, ready prepared, assembly/serve to replace conventional.	Energy savings in the local school food service, but higher production costs in some cases.
		Install automatic opening and closing doors or "drive through" composition doors for deliveries and storage of food items within the food service.	Prevents the doors from standing open and allowing hot or cold air flow needlessly. Conserves the energy of heating and cooling air systems.

Life-Cycle Cost

This method involves the conversion of savings from an energy-related investment into net present worth and allows direct comparison to maximize the returns to the operator on his energy conservation investment. For example, in considering a new blender and choosing between two brands, Brand A costing $750 and Brand B costing $500, one must request the dealers to provide estimates of the yearly operating cost of each brand. Assume operating costs are $250 and $320 for Brand A and B, respectively. If energy costs are increasing at 10% per year, the cost of money is 10%, and the blenders have a 10-year life expectancy, the life cycle cost of Brand A will be $3,123 and the life cycle cost of Brand B will be $3,409. A larger piece of equipment such as a convection oven costing $6,298 will provide a much greater savings.

Considering only the initial cost of a piece of equipment or system may not yield optimum results. Whenever the manager plans to make an energy-related investment, professional help should be obtained to compute life cycle costs.

As the school food service manager plans the energy conservation program, it may require additional funds. Management will need sufficient information to justify this investment. When discussing financial needs, the following information is necessary:

- Cost of the proposed investment,
- Operating statement for the past 1 - 3 years,
- Projected operating statement showing energy and dollar savings, and
- Financial statements.

Developing an Energy Plan

The calculation of energy usage is both important and time consuming. Results of the calculations can serve as a guide in assisting the food service manager and Energy Planning and Operational Teams in determining conservation activities. Should the calculation of energy usage not be done, conservation activities can be planned based on energy use estimates of food service equipment. A listing of estimates of energy use for equipment is provided in the Technical Information section of this manual.

Information gained from the energy audit and energy use provides the information from which to develop an Energy Management Plan. The Energy Planning and Operational Teams need to coordinate efforts in developing energy management short and long-term goals and objectives. The overall plan must include a review of food service objectives, financial resources, production requirements, and human resources.

An energy conservation goal should be established and operational activities developed to guide energy management efforts. An example of a goal might be to reduce energy use by 20% over a period of two years. To meet the goal, operational activities can be developed. Activities must be realistic. Examples would be:

Activity 1: Schedule baking so that ovens are used 20% less.

Activity 2: Replace gaskets on all walk-in refrigerators and freezers.

Activity 3: Plan menus to balance high energy demands over the production week.

Activity 4: Train personnel to reduce walk-in refrigerator entry times by 10%.

Begin to plan realistic activities so that meaningful results can be obtained. The ideal is to develop activities for a three to four-year plan that incorporates short and long-term goals. The plans for conservation measures over several years is practical due to ongoing operational demands and resource planning. A work sheet to document these activities is shown in Figure 15 and the Sample Forms section.

The activities provide a framework for achieving energy conservation goals. Three operational activities can be done during the planning stages: Listing of energy-consuming equipment, employee training, and communication.

Listing Energy-Consuming Equipment

The first activity is to compile or update a list of energy-consuming equipment. Included with the list would be specific information needed to inventory and calculate energy usage. See food service areas listed on page 7 for details. Examples of equipment records are shown in Figures 4 and 6-9, pages 11-16.

Employee Training

The second activity, employee training, is an ongoing process that is important to energy management. Employee involvement and support is needed for a successful energy conservation program.

Initial training would include an explanation of the goal and operational activities identified for the energy conservation program. Write activities in understandable operational terms for clarity. A walk-through of the food service facility should be conducted with the employees and suggested techniques or procedures discussed for optimal use equipment as it relates to menu and energy requirements. An example would be to discuss and determine how the equipment can be used to capacity. The ovens and steamers need to be filled, and other pieces of equipment scheduled to get the most product for the energy used.

Energy conservation topics should be included in regularly scheduled training activities. Energy conservation will be a constant part of food service management, therefore, energy conservation

Figure 15. Energy Management Plan.

ENERGY MANAGEMENT PLAN

Year ________

Goals and Activities	To be Completed by Date	Person Responsible	Initial when completed	Comments
Goal 1.				
<u>Activities</u>				
1.				
2.				
3.				
4.				
5.				

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training will be necessary for all new employees. Training on new procedures and routines will be ongoing for all employees.

Communication System

The last activity is establishment of a communication system to report energy management activities. The routine audit records performed on a monthly or quarterly basis will serve as a communication tool to the management teams. In addition, equipment use standards and records can be developed. This can be done for all major production equipment.

Menu management is a communication tool and needs to include energy as a variable when planning menus. As a consequence of menu planning, production scheduling for energy conservation will be enhanced.

A system for sharing energy conservation results with employees, Energy Planning Team, Energy Operational Team, and customers should be planned. This plan can include reports, posters, newsletters, awards, and other communication media.

Communication on progress towards meeting activities and goals should be made monthly. When activities are achieved, plan to maintain the system and establish new activities, as appropriate. The energy management process is ongoing and soon it becomes a routine part of the food service system.

There are times when energy conservation cannot be applied if other resources are critical, as in the case of employee scheduling and menu item quality requirements. However, energy should be a consideration in the school food service manager's decision-making process when planning the total menu.

FUTURE CONSIDERATIONS

To forecast the future of energy use in school food service is to speculate the trends of the consumer and the environment. Trends in population, food choices, implementation, and environmental impact are indicators for planning all food service changes.

Customers are becoming more informed and insist on appropriate and high quality food. Customers respond to regional and "healthy" foods that are presented well and served quickly. The focus gradually is moving away from fried foods in order the reduce the fat content of the menu. Baking and steaming can become the major preparation methods.

Energy considerations can take an indirect but important role in meeting the customer's food preferences. One area of opportunity is the focus on food service equipment. Equipment can be purchased for multiple uses such as steaming, baking, or sauteing. Smaller batch food production with capability to provide several regional or ethnic menu items at any meal should be investigated. The equipment manufacturer will continue to develop and provide energy efficient equipment. More automatic control and recycling of energy will be in the forefront. Equipment also will be developed to allow food service to manage human and food resources as well as energy.

Another focus should be energy conservation as it relates to clean air and the environment. Broiling and frying production methods can be decreased to not only meet nutrition trends but also to decrease wasted heat and grease to the work areas and surrounding environment.

Waste management continues to be a focus in food service as well as in the community. Reduction in the use of paper, plastic, and plastic wrap as well as recycling these products continues to be a concern of customers. Methods of incineration, reclaiming, and use reduction are key waste management techniques that will drive food service to environmental leadership and save energy.

Trends related to nutrition, high quality food, and conservation all address energy management and conservation. To incorporate energy conservation into food service, several major activities must be addressed. First, energy measurement and conservation issues should be addressed in any food service remodeling and construction. Structural and energy engineering need to accommodate the conservation trend. Second, the purchase of equipment should focus on energy use as well as production and labor needs. Third, menu and production management should contain an energy variable in addition to the traditionally recognized variables, such as nutrition, taste, color, flavor, texture, production method, cost, and employee skills. Menu items and production should be balanced to conserve energy.

Fourth, methods of conservation can be used in the service of food. For example, recyclable dishes minimize the volume of paper supplies and recoverable waste for revenue generation, environmental conservation, and air quality.

Implementation of an energy conservation program in school food service involves all people, employees and customers alike. Future energy conservation will be based on commitment from school food service managers and extensive training of personnel. School food service personnel should be trained in the energy conservation role that they will have throughout their employment. The hiring process should contain an energy focus as should new employee orientation and continued on-the-job training procedures and accountability. Customers (school children and school personnel) should be trained to conserve energy through their responsibility to recycle food and waste.

The future consideration of energy consumption in school food service should continue to develop and affect food service management. In addition, the education process of personnel and customers to energy responsibility will be enhanced. Energy conservation in food service will serve as a resource and cost management tool, an educational focus, and an environmental enhancement as natural energy resources are conserved. The need to educate children to conserve energy will be a lifetime investment.

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GLOSSARY OF TERMS

Amp: The abbreviation for ampere.

Ampere: A unit of electrical current.

Energy Audit: A methodical examination and review of energy use and conservation opportunities.

British Thermal Unit: The quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit at or near 39.2° F.

Food Service Production Systems:

Conventional: Foods are purchased in various stages of processing, and production, distribution, and service are completed on the same premises.

Commissary: Foods are purchased with little or no processing and are processed completely in a central facility. Prepared food generally is packaged in bulk or preplated and transported to satellite centers for service.

Ready prepared: Similar to the commissary system. Foods with varying degrees of processing are purchased, and the amount of production depends upon the state of the purchased food. The food items are stored either chilled or frozen and are readily available at any time for final assembly and heating for service.

Cook-Chill and *Cook-Freeze:* Variations of ready-prepared systems. In cook-chill systems most of the menu items are cooked and stored chilled for as short a time as possible. Cook-freeze menu items are cooked then frozen for as long as three months.

Assembly/serve: Foods are purchased and received completely processed and only the storage, assembly, heating, and service functions are performed in the food service operation.

Horsepower (hp): A unit of power equal in the U.S. to 746 watts.

Kilowatt (kW): 1,000 watts.

Kilowatt hour (kWh): A unit of electrical energy. A power of one kilowatt (kW) maintained for one hour produces or uses one kilowatt hour of energy.

Life cycle cost: The cost of equipment over its entire life, including operating and maintenance costs.

Payback period: The time it takes for an investment to pay for itself in cost savings.

Phase: Electricity is generally available in single phase power for smaller loads such as residential lights and appliances or in 3-phase for larger loads such as commercial and industrial equipment.

Pounds per square inch (psi): Unit of measure for gas, steam, or liquid pressure.

Power Factor: The percentage of total power (volts times amps) that is registered on a power (kW) meter.

Watt: Absolute unit of power equal to the work done at the rate of one absolute joule per second or to the rate of work represented by a current of one ampere under an electric potential of one volt and taken as the standard in the U.S. (1/746 horsepower).

Volt: A unit of electrical potential difference. Typical commercial and industrial voltages are 115, 208, 230, 277, and 460 volts.

EQUATIONS

(Equation 1 for heating elements)

KW = V x A x √ P
where: V = volts
A = Amps
P = number of phases (1 or 3)
√ = square root
kW = kilowatts

(Equation 2 for motors)

KW = HP x 0.746/motor efficiency
where: HP = horse power
efficiency = ratio of motor output to input power[1]

- or -

(Equation 3 for motors)

KW = V x A x √ P x PF
where: PF = power factor[2]

(Equation 4)

$$\text{Duty Cycle} = \frac{\text{Time operating}}{\text{Time On}}$$

(Equation 5)

kWh = kW x time x DC
where: kWh = kilowatt hours
DC = duty cycle

(Equation 6) kW x 3413 = BTU/hour

(Equation 7) HP x 2546 = BTU/hour

(Equation 8) BHP x 33,500 = BTU/hour
where: BHP = Boiler horsepower

[1]If motor efficiency is not known, use 0.80 for small motors

[2]If no power factor is available, use 0.75 for small motors

Sample Energy Record Forms

Monthly Worksheets for Energy Consumption Base

Base Year Audit Form Annual Worksheet

Monthly Worksheets for Current Year

Equipment Usage Log

Energy Management Plan

From: Wheeler, G. (ed.) (1980). *Energy Conservation Manual: Oregon Foodservice Industry*. Oregon State University, Corvallis, OR.

MONTHLY WORKSHEETS FOR ENERGY CONSUMPTION BASE

AUDIT FORM

FIRST MONTH OF BASE YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$______
Natural Gas: _____ therms	x 100,000	= ______	BTU	$______
LP Gas: ________ gal.	x 91,600	= ______	BTU	$______
Steam: ________ lbs.	x 970	= ______	BTU	$______
Electricity: _____ kWh	x 3,413	= ______	BTU	$______
	TOTAL........	______	BTU	$______

SECOND MONTH OF BASE YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$______
Natural Gas: _____ therms	x 100,000	= ______	BTU	$______
LP Gas: ________ gal.	x 91,600	= ______	BTU	$______
Steam: ________ lbs.	x 970	= ______	BTU	$______
Electricity: _____ kWh	x 3,413	= ______	BTU	$______
	TOTAL........	______	BTU	$______

THIRD MONTH OF BASE YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$______
Natural Gas: _____ therms	x 100,000	= ______	BTU	$______
LP Gas: ________ gal.	x 91,600	= ______	BTU	$______
Steam: ________ lbs.	x 970	= ______	BTU	$______
Electricity: _____ kWh	x 3,413	= ______	BTU	$______
	TOTAL........	______	BTU	$______

FOURTH MONTH OF BASE YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______ BTU		$______
Natural Gas: _____ therms	x 100,000	= ______ BTU		$______
LP Gas: ________ gal.	x 91,600	= ______ BTU		$______
Steam: ________ lbs.	x 970	= ______ BTU		$______
Electricity: _____ kWh	x 3,413	= ______ BTU		$______
	TOTAL........	______ BTU		$______

FIFTH MONTH OF BASE YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______ BTU		$______
Natural Gas: _____ therms	x 100,000	= ______ BTU		$______
LP Gas: ________ gal.	x 91,600	= ______ BTU		$______
Steam: ________ lbs.	x 970	= ______ BTU		$______
Electricity: _____ kWh	x 3,413	= ______ BTU		$______
	TOTAL........	______ BTU		$______

SIXTH MONTH OF BASE YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______ BTU		$______
Natural Gas: _____ therms	x 100,000	= ______ BTU		$______
LP Gas: ________ gal.	x 91,600	= ______ BTU		$______
Steam: ________ lbs.	x 970	= ______ BTU		$______
Electricity: _____ kWh	x 3,413	= ______ BTU		$______
	TOTAL........	______ BTU		$______

SEVENTH MONTH OF BASE YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$________
Natural Gas: _____ therms	x 100,000	= ______	BTU	$________
LP Gas: ________ gal.	x 91,600	= ______	BTU	$________
Steam: ________ lbs.	x 970	= ______	BTU	$________
Electricity: _____ kWh	x 3,413	= ______	BTU	$________
	TOTAL........	______	BTU	$________

EIGHTH MONTH OF BASE YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$________
Natural Gas: _____ therms	x 100,000	= ______	BTU	$________
LP Gas: ________ gal.	x 91,600	= ______	BTU	$________
Steam: ________ lbs.	x 970	= ______	BTU	$________
Electricity: _____ kWh	x 3,413	= ______	BTU	$________
	TOTAL........	______	BTU	$________

NINTH MONTH OF BASE YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$________
Natural Gas: _____ therms	x 100,000	= ______	BTU	$________
LP Gas: ________ gal.	x 91,600	= ______	BTU	$________
Steam: ________ lbs.	x 970	= ______	BTU	$________
Electricity: _____ kWh	x 3,413	= ______	BTU	$________
	TOTAL........	______	BTU	$________

TENTH MONTH OF BASE YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______	BTU	$________
Natural Gas: _____ therms	x 100,000	= _______	BTU	$________
LP Gas: ________ gal.	x 91,600	= _______	BTU	$________
Steam: ________ lbs.	x 970	= _______	BTU	$________
Electricity: _____ kWh	x 3,413	= _______	BTU	$________
	TOTAL........	_______	BTU	$________

ELEVENTH MONTH OF BASE YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______	BTU	$________
Natural Gas: _____ therms	x 100,000	= _______	BTU	$________
LP Gas: ________ gal.	x 91,600	= _______	BTU	$________
Steam: ________ lbs.	x 970	= _______	BTU	$________
Electricity: _____ kWh	x 3,413	= _______	BTU	$________
	TOTAL........	_______	BTU	$________

TWELFTH MONTH OF BASE YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______	BTU	$________
Natural Gas: _____ therms	x 100,000	= _______	BTU	$________
LP Gas: ________ gal.	x 91,600	= _______	BTU	$________
Steam: ________ lbs.	x 970	= _______	BTU	$________
Electricity: _____ kWh	x 3,413	= _______	BTU	$________
	TOTAL........	_______	BTU	$________

BASE YEAR AUDIT FORM ANNUAL WORKSHEET

School ______________________ Building Area ______________________ sq. ft.

(1) Service for Month	(2) Total Energy Consumption (BTU)	(3) Total Energy Costs ($)	(4) Number of Meals Served	(5) Energy Use Per Meal Served (BTU/Meal)	(6) Energy Use Index (BTU/Sq. Ft.)
TOTAL					
AVERAGE					

MONTHLY WORKSHEETS FOR CURRENT YEAR

FIRST MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______ BTU	$________
Natural Gas: _____ therms	x 100,000	= _______ BTU	$________
LP Gas: ________ gal.	x 91,600	= _______ BTU	$________
Steam: ________ lbs.	x 970	= _______ BTU	$________
Electricity: _____ kWh	x 3,413	= _______ BTU	$________
	TOTAL........	_______ BTU	$________

SECOND MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______ BTU	$________
Natural Gas: _____ therms	x 100,000	= _______ BTU	$________
LP Gas: ________ gal.	x 91,600	= _______ BTU	$________
Steam: ________ lbs.	x 970	= _______ BTU	$________
Electricity: _____ kWh	x 3,413	= _______ BTU	$________
	TOTAL........	_______ BTU	$________

THIRD MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______ BTU	$________
Natural Gas: _____ therms	x 100,000	= _______ BTU	$________
LP Gas: ________ gal.	x 91,600	= _______ BTU	$________
Steam: ________ lbs.	x 970	= _______ BTU	$________
Electricity: _____ kWh	x 3,413	= _______ BTU	$________
	TOTAL........	_______ BTU	$________

FOURTH MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$________
Natural Gas: _____ therms	x 100,000	= ______	BTU	$________
LP Gas: ________ gal.	x 91,600	= ______	BTU	$________
Steam: ________ lbs.	x 970	= ______	BTU	$________
Electricity: ______ kWh	x 3,413	= ______	BTU	$________
	TOTAL........	______	BTU	$________

FIFTH MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$________
Natural Gas: _____ therms	x 100,000	= ______	BTU	$________
LP Gas: ________ gal.	x 91,600	= ______	BTU	$________
Steam: ________ lbs.	x 970	= ______	BTU	$________
Electricity: ______ kWh	x 3,413	= ______	BTU	$________
	TOTAL........	______	BTU	$________

SIXTH MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$________
Natural Gas: _____ therms	x 100,000	= ______	BTU	$________
LP Gas: ________ gal.	x 91,600	= ______	BTU	$________
Steam: ________ lbs.	x 970	= ______	BTU	$________
Electricity: ______ kWh	x 3,413	= ______	BTU	$________
	TOTAL........	______	BTU	$________

SEVENTH MONTH OF CURRENT YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$______
Natural Gas: _____ therms	x 100,000	= ______	BTU	$______
LP Gas: _______ gal.	x 91,600	= ______	BTU	$______
Steam: _______ lbs.	x 970	= ______	BTU	$______
Electricity: _____ kWh	x 3,413	= ______	BTU	$______
	TOTAL........	______	BTU	$______

EIGHTH MONTH OF CURRENT YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$______
Natural Gas: _____ therms	x 100,000	= ______	BTU	$______
LP Gas: _______ gal.	x 91,600	= ______	BTU	$______
Steam: _______ lbs.	x 970	= ______	BTU	$______
Electricity: _____ kWh	x 3,413	= ______	BTU	$______
	TOTAL........	______	BTU	$______

NINTH MONTH OF CURRENT YEAR: ____________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 ______ gal.	x 140,000	= ______	BTU	$______
Natural Gas: _____ therms	x 100,000	= ______	BTU	$______
LP Gas: _______ gal.	x 91,600	= ______	BTU	$______
Steam: _______ lbs.	x 970	= ______	BTU	$______
Electricity: _____ kWh	x 3,413	= ______	BTU	$______
	TOTAL........	______	BTU	$______

TENTH MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______ BTU	$________
Natural Gas: _____ therms	x 100,000	= _______ BTU	$________
LP Gas: ________ gal.	x 91,600	= _______ BTU	$________
Steam: ________ lbs.	x 970	= _______ BTU	$________
Electricity: ______ kWh	x 3,413	= _______ BTU	$________
	TOTAL........	_______ BTU	$________

ELEVENTH MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______ BTU	$________
Natural Gas: _____ therms	x 100,000	= _______ BTU	$________
LP Gas: ________ gal.	x 91,600	= _______ BTU	$________
Steam: ________ lbs.	x 970	= _______ BTU	$________
Electricity: ______ kWh	x 3,413	= _______ BTU	$________
	TOTAL........	_______ BTU	$________

TWELFTH MONTH OF CURRENT YEAR: ________________

TOTAL MONTHLY CONSUMPTION AND COSTS:

Fuel Oil #2 _______ gal.	x 140,000	= _______ BTU	$________
Natural Gas: _____ therms	x 100,000	= _______ BTU	$________
LP Gas: ________ gal.	x 91,600	= _______ BTU	$________
Steam: ________ lbs.	x 970	= _______ BTU	$________
Electricity: ______ kWh	x 3,413	= _______ BTU	$________
	TOTAL........	_______ BTU	$________

EQUIPMENT USAGE LOG

SCHOOL ______________________ SITE ______________________

EQUIPMENT ______________________ BRAND ______________________

SERIAL # ______________________ MODEL # ______________________

SITE ID ______________________ RPM ______________________

kW ________ VOLTS ________ AMPS ________ PHASE ________

HP ________ BTU ________

TIME	ON/OFF	TEMPERATURE	COMMENTS

ENERGY MANAGEMENT PLAN

Year ______

Goals and Activities	To be Completed by Date	Person Responsible	Initial when completed	Comments
Goal 1. <u>Activities</u> 1. 2. 3. 4. 5.				

READING UTILITY COMPANY METERS[1]

[1]*Facilities Operations Manual* (pp. 72 - 75), 1986, Washington, D.C: National Restaurant Association. Reprinted with the permission of the National Restaurant Association.

AUDIT YOUR CURRENT STATUS

Just as you take inventory of your stock on hand and examine your sales before you place orders for products, you must take inventory of your current energy use and costs.

Reading meters with the utility company's reader will verify the information which appears on the subsequent bill. In addition, reading meters at other than normal utility company billing periods will enable you to determine usage during your own customary operational control periods, such as weeks or months.

Auditing utility company bills will not only enable you to compare your own meter readings with those of the utility companies but will help you to develop an awareness of how your billing is determined.

This section covers electrical, gas and water billing, but other purchased utilities or fuels, such as steam, chilled water, fuel oil or propane, could be tracked in a similar manner.

Energy surveys will provide you the facts about where energy is being consumed in your operation and where deficiencies exist in your physical facilities. This information will identify the areas where energy conservation efforts should be focused, where changes in operations or equipment should be implemented and where renovations and improvements should be made to your building and mechanical systems.

Reading Utility Company Meters

<u>Electric Meters</u>

Two major types of electric meters used by the utility companies are:

- Kilowatt hour meter for customers where the rate schedule is based only on kilowatt hours used.
- Kilowatt hour meter with a demand meter for commercial customers where the rate schedule is based not only on kilowatt hours used but also on the maximum demand or requirement during the billing period (usually 15 to 30 minutes).

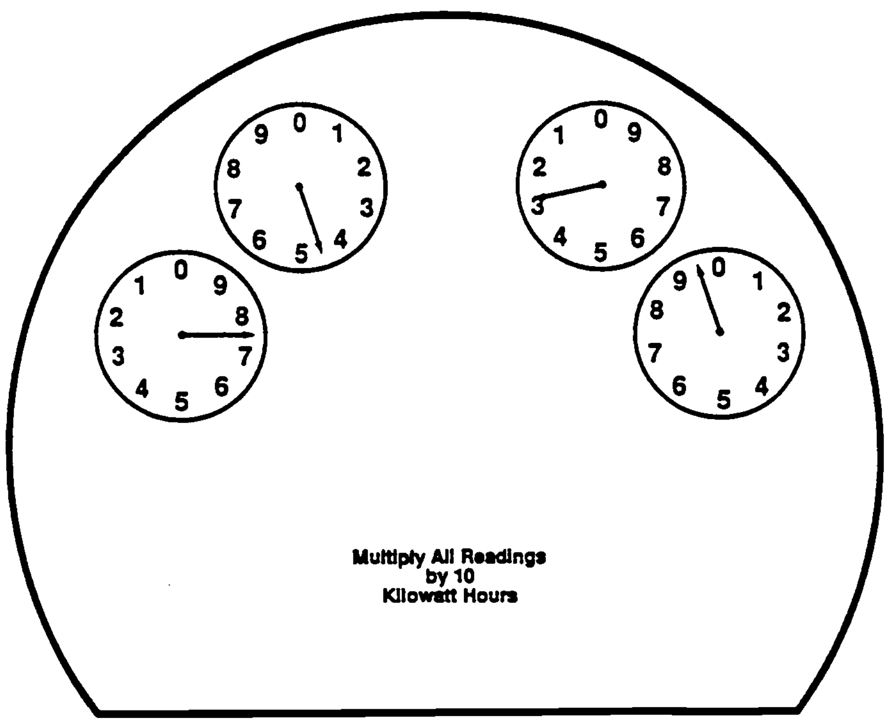
Kilowatt Hour Meters

Meter dials are read in sequence from left to right, with the number recorded being the lower of the numbers between which the hand points in each dial. In Figure 16, the first dial is read as 7; the second dial, 4; the third dial, 2; and the fourth dial, 9 because it has not reached 0 but is between 9 and 0. Thus the meter reading is 7429.

It may aid in your understanding how a meter dial works if you recognize that the hand on the dial at the extreme right completes one full circle, and the hand on the dial to its left moves only between two numbers. The same relationship exists between other adjacent dials.

The face of the meter may have the words "multiply all readings by ___." If this appears on your meter, the indicated multiple must be used to obtain the actual kilowatt hour reading.

Figure 16. Kilowatt Hour Meter.



Kilowatt Hour Meter with Kilowatt Demand Meter

Where the electric rate schedules are based on kilowatt hours and the maximum kilowatt demand or requirement in a 15- or 30-minute interval in the billing period, the utility company installs a meter which records demand as well as the kilowatt hours used.

The demand meter may be a separate unit, or it may be part of the kilowatt hour meter. Since many different types of demand meters are used, each of which may be read in a different way, we recommend that you ask your utility company for instructions on how to read the demand meter at your property. However, to give you a feel of the subject, Figures 17 and 18 are illustrations of two types of combined meters in common use, along with an explanation of the demand indicated.

Figure 17 shows a pointer which indicates the maximum demand on the outer scale. The scale may be read directly, or a multiplier may be required. The demand indicated is 0.6 kilowatts. The meter directs that all demand readings be multiplied by 10. Therefore, the demand for the billing period is (0.6 x 10) = 6 kilowatts. The meter reader resets the indicator to zero. The kilowatt hour reading is 7048.

Figure 17. Kilowatt Hour Meter with Kilowatt Demand Meter.

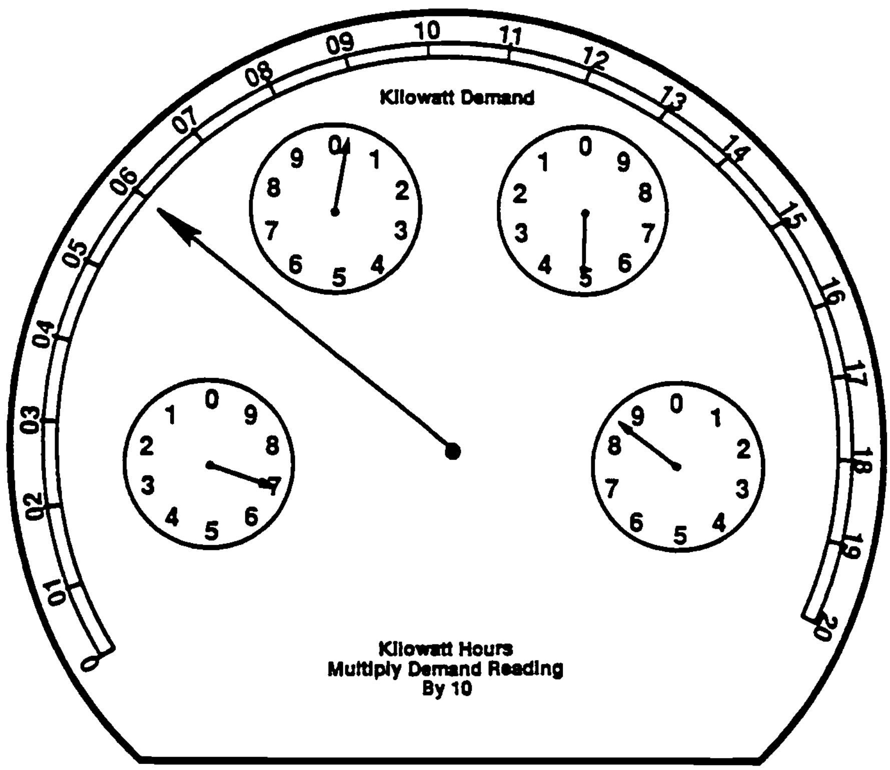
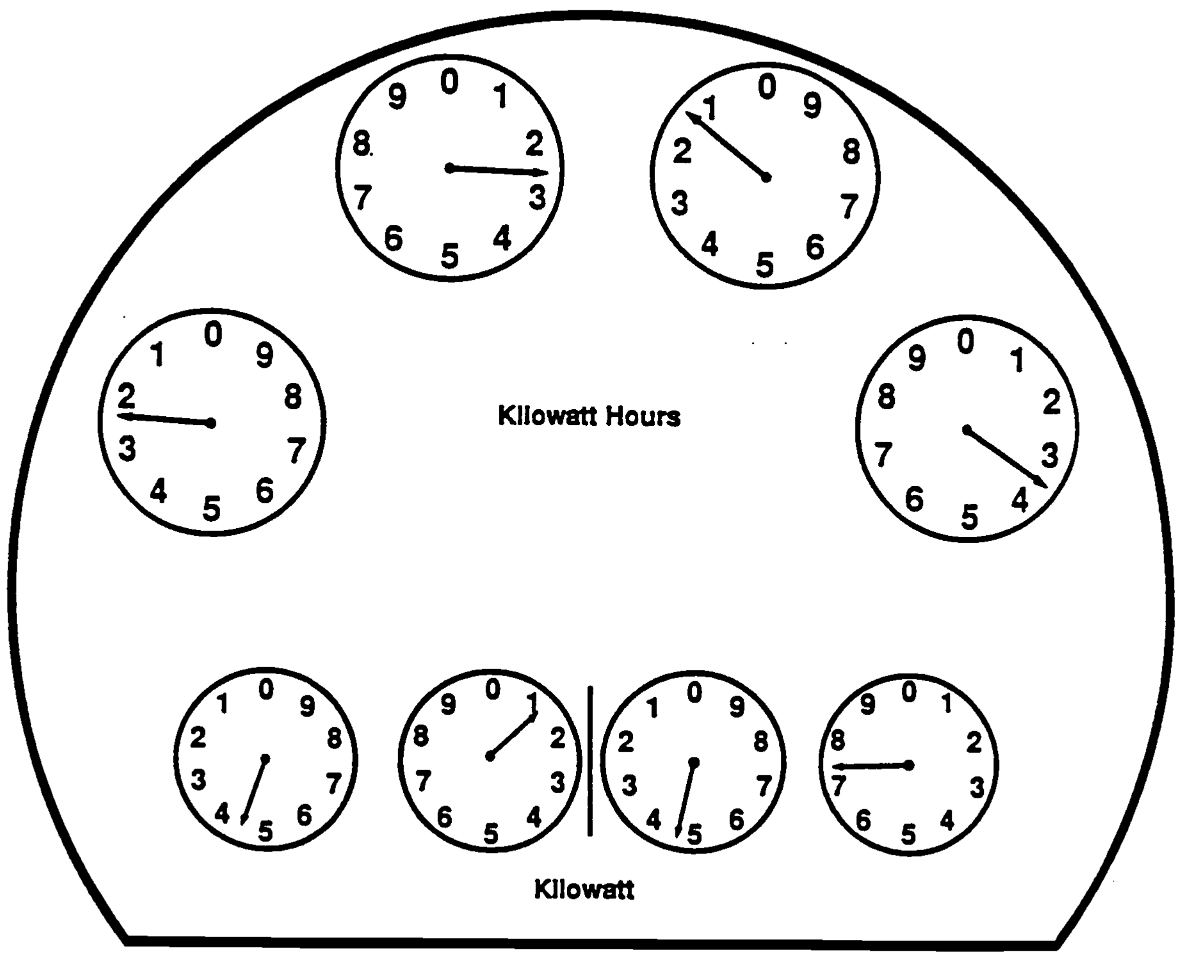


Figure 18 shows a meter with demand dials. These dials are read from left to right in the same way as kilowatt hour meters. The vertical line between dials indicates the position of the decimal point. If there is a multiplier shown on the dial face, the reading must be multiplied by that number. In Figure 18, the demand indicated is 41.47 kilowatts. Demand dials are reset to zero by the meter reader each time after a reading is taken. The kilowatt hour meter reading is 2213.

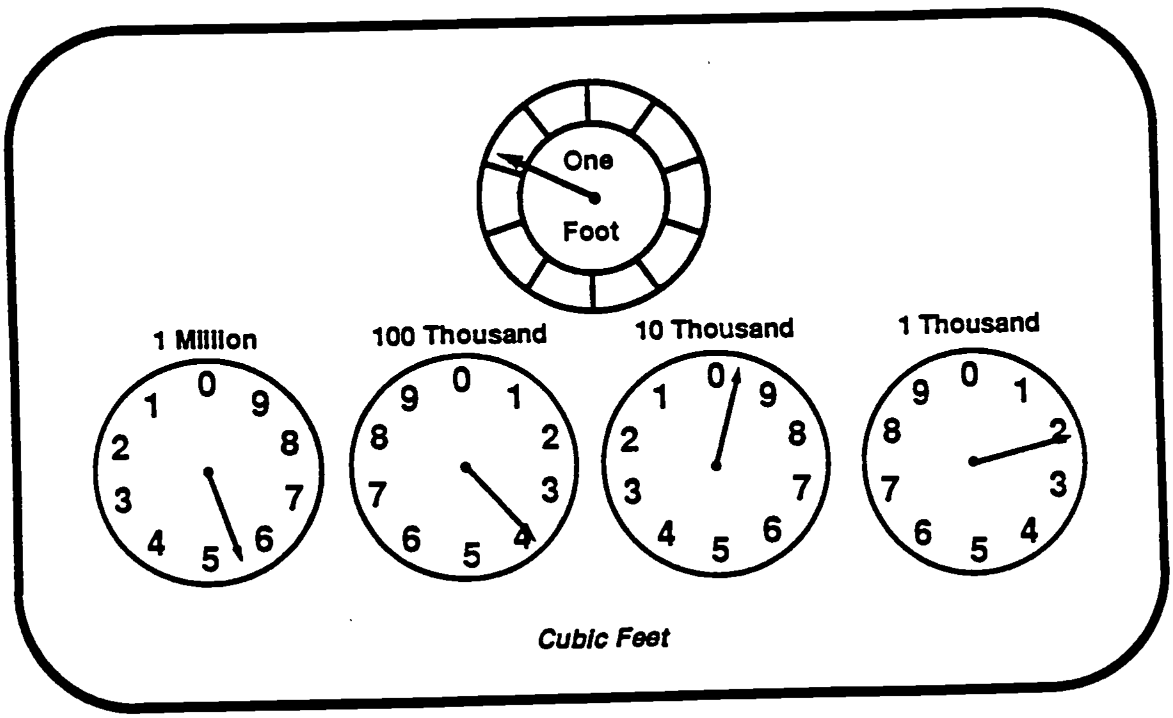
Figure 18. Kilowatt Hour Meter with Kilowatt Demand Meter.



Gas Meters

One type of gas meter is shown in Figure 19. The lower row of dials is read in sequence from left to right, and values are determined as with electric meters. In Figure 19, the first dial is read as 5; the second dial, 3; the third dial, 9 because it has not yet reached 0 but is between 9 and 0; and the fourth dial, 2. The reading of Figure 19 is 5392 hundred cubic feet. The single upper dial is used only to test the meter and is not read. Consult with your local gas utility for assistance to properly read your meter.

Figure 19. Gas meter.



BTU RATING LIST[2]

[2]*Facilities Operations Manual* (pp. 77 - 82), 1986, Washington, DC: National Restaurant Association. Reprinted with the permission of the National Restaurant Association.

Other sources for assistance in determining BTU rating of equipment are:

Building Engineer
Utility Company
Equipment Catalogs
Equipment Dealers
Equipment Maintenance Manuals

Manageable Equipment

	*BTU Rating		
Description of Equipment	Gas	Electric	Steam
Braising Pans			
Braising pan - floor model small	50 M	17 M	
Braising pan - floor model large	96 M	29 M	
Braising pan - table top	11 M		
Broilers			
Single deck radiant without oven	110 M	55 M	
Oven for broiler above	34 M	12 M	
Single deck infrared with finishing oven	79 M	41 M	
Warming oven for broiler above	34 M	12 M	
Double deck infrared without oven	154 M	109 M	
Twin infrared with oven and finishing oven	202 M		
Char-type without oven 36 wide	95 M	41 M	
Backshelf broiler (Salamander)	40 M	18 M	
Conveyor broiler	110 M	82 M	
Coffee Equipment			
Coffee urn - twin (3) gal.	28 M	19 M	40 M
Coffee urn - twin (6) gal.	28 M	29 M	56 M
Coffee urn - twin (10) gal.	28 M	36 M	58 M
Coffee maker - (2) pot		4 M	
Coffee maker - (5) pot		9 M	
Coffee warmer - single burner		1 M	
Coffee warmer - (2) burner		1 M	
Coffee warmer - (4) burner		4 M	
Conveyor Belt		1 M	

*M = 1,000 BTU's/hour

Manageable Equipment (cont.)

Description of Equipment	*BTU Rating Gas	Electric	Steam
Dishwashing			
Flight type dishwasher		126 M	46 M
2 Tank conveyor type dishwasher	145 M	92 M	38 M
1 Tank conveyor type dishwasher	71 M	58 M	32 M
Square door type dishwasher	18 M	16 M	30 M
Potwasher (single Rack)		28 M	
Potwasher (double Rack)		54 M	
Food Warmers			
1 section (similar to roll-in refrigerator)		4 M	
3 compartment thermotainer		4 M	
6 compartment thermotainer		7 M	
9 compartment thermotainer		8 M	
2 stack plate dispenser/warmer		2 M	
4 stack plate dispenser/warmer		4 M	
Pellet warmer - 30 pellets		2 M	
Pellet warmer - 60 pellets		3 M	
Pellet warmer - 90 pellets		3 M	
Pellet warmer - 180 pellets		10 M	
Pellet warmer - 240 pellets		13 M	
Refrigerated ice bed - 8 sq.ft.		.5 M	
Refrigerated ice bed - 8 to 15 sq.ft.		.7 M	
Hot food well (each)		2 M	
Hot food well - single control for multiple wells		2 M/sq.ft.	
1 drawer roll warmer		1 M	
2 drawer roll warmer		2 M	
3 drawer roll warmer		3 M	
Bain Marie heater - 4 sq.ft.	8 M	2.7 M/sq.ft.	
Bain Marie heater - 12 sq.ft.	25 M	2.7 M/sq.ft.	
Steam Table		1.4 M/sq.ft.	

*M = 1,000 BTU's/hour

Manageable Equipment (cont.)

Description of Equipment	Gas	*BTU Rating Electric	Steam
Food Warmers (cont.)			
Proof cabinet (1 rack)		9 M	29 M
Proof cabinet (2 racks)		17 M	56 M
Fryers			
Floor model 18 lbs	53 M	10 M	
Floor model 45 lbs	72 M	60 M	
Floor model 60 lbs	120 M	66 M	
Floor model 100 lbs	132 M	66 M	
Floor model - Donut 105 lbs	120 M	66 M	
Counter model - Robut Doughnut Fryer		13 M	
Lights, Fluorescent		.03M/ft.	
Ovens			
Convection oven - single compartment	68 M	45 M	
Convection oven - double compartment	136 M	90 M	
Convection oven - compact type		18 M	
Roast oven - 2 deck	61 M	25 M	
Roast oven - 3 deck	91 M	38 M	
Deck oven - 2 deck	64 M	49 M	
Deck oven - 3 deck	96 M	74 M	
Revolving oven - 5 tray x 15 pan	141 M	66 M	
Revolving oven - 6 tray x 24 pan	193 M	111 M	
Revolving oven - 6 tray x 36 pan	265 M	119 M	
Ranges			
Uniform heat top without oven	120 M	54 M	
Oven for range above	37 M	12 M	
Grate top without oven	20 M/burner	7 M/burner	
Oven for range above	37 M	12 M	
Fry top without oven	90 M	76 M	
Oven for range above	37 M	12 M	
Narrow Range (1) ft. wide/no oven	40 M	18 M	

*M = 1,000 BTU's/hour

Manageable Equipment (cont.)

Description of Equipment	*BTU Rating Gas	Electric	Steam
Short Order Cooking Equipment			
Griddle - 2 foot counter type	44 M	31 M	
Griddle - 3 foot counter type	66 M	33 M	
Griddle - 6 foot counter type	132 M	87 M	
Fryer - 15 lbs counter type	40 M	19 M	
Fryer - 30 lbs counter type	48 M	33 M	
Fryer - 40 lbs counter type	56 M	49 M	
Hot Plate - 2 burner counter type	32 M	14 M	
Steam Kettles			
Table type - 5 gal.	24 M	16 M	7 M
Floor model - 20 gal.	48 M	44 M	28 M
Floor model - 30 gal.	60 M	58 M	42 M
Floor model - 40 gal.	96 M	82 M	55 M
Floor model - 60 gal.	108 M	82 M	83 M
Steam Kettle/Steamer Combination			
3 compartment steamer & 40 gal. kettle	136 M	98 M	110 M
3 compartment steamer & (2) 5 gal. kettles	136 M	102 M	97 M
3 compartment steamer & (2) 40 gal. kettles	136 M	131 M	138 M
High pressure steamer & 5 gal. kettle	136 M	66 M	83 M
High pressure steamer & 40 gal. kettle	136 M	66 M	138 M
Steamers			
Convection steamer - 2 compartment	128 M	66 M	42 M
Compartment steamer - 3 compartment	200 M	98 M	83 M
Steam-It	32 M	33 M	28 M
High pressure steamer	136 M	66 M	83 M
Toasters			
Conveyor toaster - small	16 M	14 M	
Conveyor toaster - large	22 M	22 M	

*M = 1,000 BTU's/hour

Self-Managing Equipment

		*BTU Rating	
Description of Equipment	Gas	Electric	Steam
Food Preparation Equipment			
12 quart mixer		1 M	
20 quart mixer		1 M	
30 quart mixer		1 M	
60 quart mixer		3 M	
80 quart mixer		4 M	
Slicer - manual feed		1 M	
Slicer - automatic feed		1 M	
Vertical cutter/mixer 25 quart		13 M	
Vertical cutter/mixer 40 quart		31 M	
Vertical cutter/mixer 60 quart		66 M	
Food cutter - 15" bowl		1 M	
Food cutter - 18" bowl		3 M	
Vegetable Peeler 30-33 lbs.		2 M	
Vegetable Peeler 50-60 lbs.		3 M	
Ovens			
Microwave oven (model 70/40)		5 M	
Microwave oven (model 70/80)		18 M	
Waste Disposal Equipment			
Disposer 1/2 HP		1 M	
Disposer 1 HP		3 M	
Disposer 1-1/2 HP		4 M	
Disposer 2 HP		5 M	
Disposer 3 HP		8 M	
Disposer 5 HP		13 M	
Disposer 7-1/2 HP		19 M	
Trash compactor - single bag		3 M	
Trash compactor - double bag		5 M	
Trash compactor - small size		1 M	
Waste pulping system - 400 lbs./hour		13 M	
Waste pulping system - 600 lbs./hour		19 M	
Waste pulping system - 1500 lbs./hour		65 M	

*M = 1,000 BTU's/hour

Non-Controllable Equipment

Description of Equipment	Gas	*BTU Rating Electric	Steam
Beverage Equipment			
Milk dispenser - 5 gal.		1 M	
Milk dispenser - 10 gal.		1 M	
Milk dispenser - 15 gal.		2 M	
Freezers - Reach-In			
1 section freezer		2 M	
2 section freezer		4 M	
3 section freezer		6 M	
1 section freezer - undercounter type		2 M	
Freezer - Walk-In			
Freezer - 8' x 10'		4 M	
Freezer - 8' x 14'		4 M	
Heating, Ventilation, Air Conditioning System			
Check with building engineer for energy usage data			
Ice Cream			
Soft serve ice cream machine - single		3 M	
Soft service ice ream machine - twin		4 M	
Ice cream cabinet - 27 gal. cap.		.2 M	
Ice cream cabinet - 48 gal. cap.		.2 M	
Ice cream cabinet - 63 gal. cap.		.2 M	
Ice Making Equipment			
Ice cube maker - 350 lb.		2 M	
Ice cube maker - 650 lb.		2 M	
Flaked ice maker - 450 lb.		1 M	
Flaked ice maker - 700 lb.		1 M	
Flaked ice dispenser - 500 lb.		1 M	
Flaked ice dispenser - 650 lb.		1 M	
Flaked ice dispenser - 700 lb.		1 M	
Lowerator, Refrigerated			
20" x 20" rack		1 M	

*M = 1,000 BTU's/hour

Non-Controllable Equipment (cont.)

	*BTU Rating		
Description of Equipment	Gas	Electric	Steam
Refrigerators - Reach-In			
1 section refrigerator		3 M	
2 section refrigerator		4 M	
3 section refrigerator		4 M	
1 section refrigerator - undercounter type		3 M	
Refrigerators - Walk-In			
Refrigerator - 8' x 10'		4 M	
Refrigerator - 8' x 14'		4 M	

*M = 1,000 BTU's/hour

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