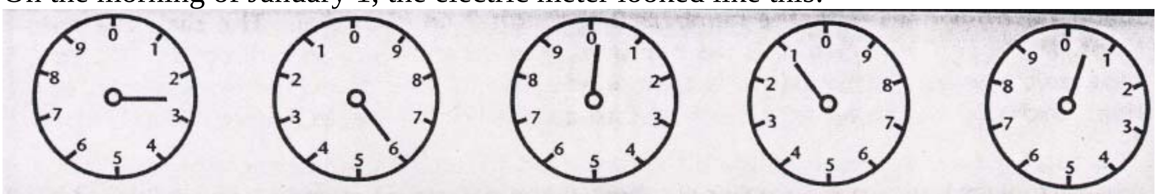
READING AN ELECTRIC METER

A typical analog (dial-type) electric meter has five dials. On the first dial, the numbers increase in a clockwise direction. On the next dial, the numbers increase in a counter clockwise direction. Each dial alternates from clockwise to counter clockwise, as you can see below. To read the meter: If the pointer is between two numbers, always record the smaller number. If the pointer is between 9 and 0, record 9, since 0 represents 10.

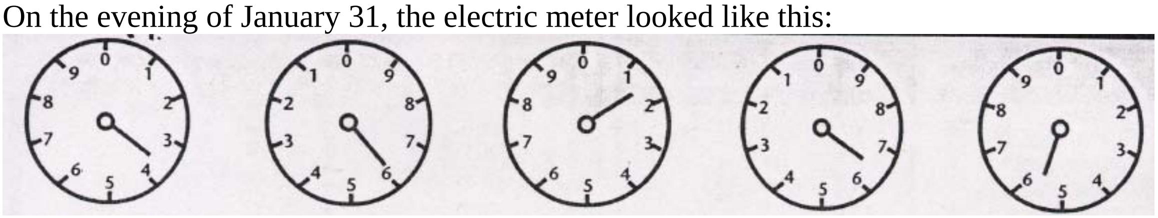
METER READING EXAMPLE

On the morning of January 1, the electric meter looked like this:



____ ____ ____ ____ ____

On the evening of January 31, the electric meter looked like this:



____ ____ ____ ____ ____

1. How many kilowatt-hours of electricity were used during January?

2. If the cost of electricity is $0.14 (14 cents) per kWh, how much did the electricity cost for January?

3. What was the average cost of electricity per day during January?

Note: Utilities are making increasing use of digital electric meters in place of analog meters. Digital meters are easier to read and can display a variety of information such as instantaneous power demand, peak power demand, and cumulative kWh use.

FIGURING KILOWATT-HOURS AND COSTS

1. Formula for figuring kilowatt-hours:

(Watts/1000) x hours of use = kWh

2. Using kWh to figure out how much energy is used in one month- example:

Light bulb rating: 75 Watts

75 W/1000 = 0.075 kW

Used 5 hours per day for one month: 5 x 30 = 150 hours per month

Multiply 150 hours x 0.075 kW = 11.25 kWh per month

3. Using kWh to figure yearly costs:

• Estimate the number of hours the device will be used during a year. Then multiply this by the charge from the utility per kWh.

• **Here's the formula for figuring yearly costs:**

Watt rating/1000 x number of hours on per year x cost per kWh = yearly cost

• **Here's an example using the rate of $.14 per kWh:**

100W/1000 = 0.10 kW

4 hours per day for a year: 4 hrs x 365 (days in year) = 1,460 hrs/yr

Determine kWh: 0.10 kW x 1,460 hrs/yr = 146 kWh/yr

Cost per yr, using $0.14 per kWh: 146 kWh/yr x 0.14 = $20.44 per year

TYPICAL INSTITUTIONAL/COMMERCIAL LIGHTING TECHNOLOGIES

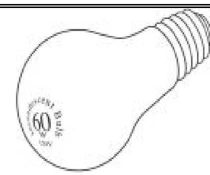
Efficacy = efficiency of a light source expressed in lumens of light *output* per watt of power *input*

Main Lighting Type	Efficacy in Lumens/Watt*
Incandescent	9 - 34
Mercury Vapor	39 - 54
Fluorescent	15 - 109
Metal Halide	65 - 106
High Pressure Sodium	55 - 136

* Efficacy expressed as a range because efficiency typically increases for a given lamp type as the lamp wattage increases, e.g. a 23W CFL is more efficient than a 15W CFL.

Specific Lighting Technologies

Watts are for bulb only; ballasts used with fluorescent and HID lamps typically increase total fixture wattage by about 10%.

Type	Watts	Lumens	Where Used	How to Recognize
Incandescent: Standard 25 W 60 W 100 W	 25 60 100	 215 860 1,750	Overall room lighting; display & accent lighting	 filament burns very hot
Incandescent: "PAR"(Parabolic aluminized reflectors) 75 W 100 W 150 W	 75 100 150	 1,200 1,750 2,580	Highly effective reflective flood light used for recessed indoor lighting & outside lighting	 have very thick glass
Incandescent: "R" (Reflector) 75 W 100 W 150 W	 75 100 150	 1,200 1,750 2,580	Reflective flood light used for recessed lighting; indoor only	 have very thin glass
Incandescent: Tubular quartz halogen 500 WQ 1000 WQ	 500 1000	 10,600 23,100	Outside safety lighting	 have a very long filament; produce clear, white light

Type	Watts	Lumens	Where Used	How to Recognize
Fluorescent: CFL (compact fluorescent lamp) 5 W 28 W	 5 28	 250 1,800	R/PAR for overall room lighting; small CFLs desk/table lamps	• Desk/table types:  • R/PAR types: resemble incandescent R & PAR, but have a ballast located before the screw threads
Fluorescent: Tubular 4ft T12 Standard T12"Supersaver"	 40 34	 3,050 2,850	Overall room lighting	 1 1/2" diam., 4 ft. long tubes found in rectangular housing; may have 1 - 4 lamps; will cast a shadow or can actually be seen, depending on housing
Fluorescent Tubular 8 ft T12 Standard T12"Supersaver"	 75 60	 6,000 5,800	Overall room lighting	1 1/2 " diam., 8 ft. long tubes in long rectangular housing typically containing two tubes; see above to count number of tubes
Fluorescent Tubular 4 ft T8 Standard	 32	 2,900	Overall room lighting	1"diam.; 4 ft. long tubes in rectangular housing; see above to count tubes
Fluorescent U-tube Standard "Supersaver"	 40 34	 3,050 2,850	Overall room lighting	
HID (high intensity discharge): Mercury Vapor 175 W 400 W	 175 400	 7,300 21,000	Outside safety lighting; sometimes in gyms	 Have a clear "arc" tube inside the lamp; bluish light
HID: Metal Halide 400 W 1000 W	 400 1000	 32,000 _____	Used in gyms & other spaces with high ceilings; mostly for outdoor lighting	Resemble HID mercury vapor lamps; Look for white caps on one or both arc tube ends; very bright light
HID: High pressure sodium 70 W 100 W 400 W	 70 100 400	 6,300 9,500 50,000	Mostly used for safety and roadway lighting	Resemble mercury vapor lights; have very slender, ceramic arc tube

COMPARING LIGHT TECHNOLOGIES:
CONSUMPTION, LIFETIMES, & COSTS

1. Figure Lifetime Electrical Consumption

- First learn the lamp's lifetime in hours. Multiply it by wattage/1000 to reach the lamp's lifetime electrical consumption in kWh.
- The formula: Lifetime (hours) x wattage/1000 = lifetime consumption in kWh

2. Calculate Lifetime Cost

- Next figure lifetime cost by multiplying the energy consumption by the utility electric rate, then adding this to the lamp's initial cost.
- The formula is: (lifetime energy consumption in kWh x electric rate in $ per kWh) + cost of lamp = lifetime cost

3. Don't Stop at Lifetime Cost!

- If you stop calculating at the lifetime cost you'll think the CFL is still way more expensive!
- Comparing lifetimes is like comparing apples and oranges, since the amounts are so different (remember - 10,000 hours for the CFL vs. 1,000 for the incandescent)!

4. The Right Stuff: Hourly Cost

- So, in order to make a comparison, you can figure the actual cost per hour to operate each lamp.
- Then you are asking each lamp to do the same amount of work for the same time period.

5. The Bottom Line: Hourly Cost

- Divide lifetime cost by the lamp's lifetime in hours to give the hourly operating cost.
- Here's the formula: $\text{hourly cost} = \dfrac{\text{lifetime cost}}{\text{lifetime in hours}}$

Example: Which Lamp Costs More Per Hour to Use?

13 W CFL

- 10,000 hr. lifetime
- $5 lamp cost
- 10,000 hr x 13W/1000 = 130 kWh lifetime consumption
- 130 kWh x $0.14/kWh = $18.20 lifetime energy cost
- $18.20 + $5 = $23.20 total lifetime cost
- hourly cost = $23.20/10,000 hrs = $.002/hr (rounded) – that's two-tenths of a cent per hour

75 W Incandescent

- 1,000 hr. lifetime
- $0.62 lamp cost
- 1,000 hr x 75W/1000 = 75 kWh lifetime consumption
- 75 kWh x $0.14/kWh = $10.50 lifetime energy cost
- $10.50 + $0.62 = $11.12 total lifetime cost
- hourly cost = $11.12/1,000 hrs = $.010/hr (rounded) – or one cent per hour, 5 times more than the CFL

LIGHTING EVALUATION WORKSHEET

Name: ______________________________ Date: ________________ Facility/Room: ______________________________

PART 1: ROOM LIGHTING DESCRIPTON

Lighting technology (circle one): incandescent / fluorescent tube / compact fluorescent / HID

Measure room light level (in foot-candles or FC) at three different places: ____________ FC ___________ FC ___________ FC

Add up the three light levels and divide by 3 to calculate average light level: ________________ FC

What is the IES recommended light level for the room? (See IES Recommended Light Levels handout) _______________ FC

Is the room overlit? _________________

If so, how many lamps do you think could be removed from each fixture without making the room underlit? ___________________

What lighting controls are in use? (circle all that apply) manual switches / occupancy sensors / timers / daylight sensors

What lighting controls should be added? ____

How is daylight being used in this room? ____

How could use of daylight be improved? ____

What light quality problems are there? (circle all that apply) glare / flicker / poor light color / dirty fixtures / loud hum

Comments:____

PART 2: EXISTING WATTS PER FIXTURE

A	B	C	D
Number of lamps per fixture	**Watts per lamp**	**Watts per fixture (A x B)**	**Adjusted Watts per fixture (1.1 x C if fluorescent or HID, 1.0 x C if incandescent)**

PART 3: EXISTING LIGHTING COSTS

What is the cost per kWh at this facility? $/kWh: ________________________

E	F	G	H	I	J	K	L
Fixture wattage (D)	**Hours on per month**	**Watt-hours per month (E x F)**	**kWh per month (G÷1000)**	**Cost per month (H x cost per kWh)**	**Cost per year (I x months room used per year)**	**Number of fixtures of this type in room**	**Total cost per year (J x K)**

Recommended energy saving strategies (check all that apply):

____ leave lighting alone, it’s already efficient

____ replace with more efficient lamps & ballasts

____ delamp to reduce over-lighting

____ add controls to reduce operating hours

PART 4: REPLACEMENT WATTS PER FIXTURE

M	N	O	P
Number of lamps per fixture *(changes if delamping)*	**Watts per lamp *(changes if switching to more efficient lamps)***	**Watts per fixture (M x N)**	**Adjusted Watts per fixture (1.1 x O if fluorescent or HID, 1.0 x O if incandescent)**

PART 5: REPLACEMENT LIGHTING COSTS

Q	R	S	T	U	V	W	X
Fixture wattage (P)	**Hours on per month *(changes if adding controls)***	**Watt-hours per month (Q x R)**	**kWh per month (S÷1000)**	**Cost per month (T x cost per kWh)**	**Cost per year (U x months room used per year)**	**Number of fixtures of this type in room**	**Total cost per year (V x W)**

PART 6: SAVINGS AND PAYBACK

Y	Z	AA	BB	CC
Savings per year (L-X)	**Equipment cost ($)**	**Labor cost ($)**	**Total cost (Z + AA)**	**Payback in years (BB÷Y)**

IES: RECOMMENDED LIGHT LEVELS

The Illuminating Engineering Society (IES) has developed guidelines for illuminance levels for a wide range of visual tasks.

TYPE OF SPACE/ACTIVITY	ILLUMINANCES (FC)
Simple orientation for short visits	5
Working spaces where simple visual tasks are performed	10
Performance of visual tasks that are:	
of high contrast and large size	30
of high contrast & small size, or low contrast & large size	50
of low contrast and small size	100
near threshold	300-1000
Libraries (reading)	30
Lounge and Waiting Areas	10
Offices:	
Paper work (#2 pencil; 8pt or 10pt print)	30
Computer use (vertical fc)	5
Accounting, bookkeeping (on paper)	30
Conference areas	30
Rest Rooms	5
Shop Areas:	
Rough to medium bench/machine work	30-50
Storage Areas	10-30
Auditorium (assembly)	10
Classrooms/Lecture Rooms:	
Regular desk work, study halls	30
Lecture rooms (audience)	30
Marker boards	5
Chalk boards, demonstration areas	50-100
Corridors, Lobbies and Stairways	5-10
Food Service Facilities:	
Food preparation task areas	50
Gymnasiums:	
General	30
Competition and events	50-150

PLUG LOAD COST ANALYSIS WORKSHEET

1. **Current Use:** Use the chart below to figure the current rate of use and current cost to run the plug loads in the audit area.
Electric rate: $_______/kWh

Current Plug Load Use & Cost

	A	B	C	D	E	F
Plug Load	**Watts**	**# hrs. used per month (estimated)**	**kWh used Per month (AxB÷1000)**	**Cost to run per month (C x electric rate per kWh)**	**# of items of this type**	**Current yearly cost (D x E x months used per yr)**
Computers						
Monitors						
Printers						
Microwave						
Fans						
Electric Space Heater						
Other (list)						

PLUG LOAD COST ANALYSIS WORKSHEET (cont'd)

2. **Adjusted Use:** In your group, estimate how many hours that the plug loads are on unnecessarily and could be turned off. Recalculate the cost of using the plug loads if the number of hours were reduced by this amount, using the chart below. For column M, subtract the value in column L of this "adjusted use" worksheet from the corresponding value in column F for the same plug load in the "current use" worksheet.

Adjusted Plug Load Use & Cost

	G	**H**	**I**	**J**	**K**	**L**	**M**
Plug Load	**Watts**	***New* # hrs. used per month (estimated)**	**kWh used Per month (GxH÷ 1000)**	**Cost to run per month (I x electric rate per kWh)**	**# of items of this type**	**Adjusted yearly cost (J x K x months used per yr)**	**Yearly Savings (F-L)**
Computers							
Monitors							
Printers							
Microwave							
Fans							
Electric Space Heater							
Other (list)							

PUTTING YOUR COMPUTER TO SLEEP

When you're not using your computer, you can save energy by putting it to "sleep." When your computer is in sleep, it's turned on but in a low power mode. It takes less time for a computer to wake up from sleep than it does for the computer to start up after being turned off.

You can choose to put the computer to sleep automatically when your computer has been inactive for a specified amount of time. You can also set only the display to sleep. If your computer is in the middle of a task that you want to let finish while you are away (for example, burning a CD or DVD), you should set only the display to sleep.

MACS (OS X)

To set the timing for your computer to sleep:

1 Choose Apple menu > System Preferences, and then click Energy Saver.
2 Click Sleep. Click Show Details, if necessary, to see the sleep settings.
3 Drag the top slider to set how long the computer should be idle before going to sleep.
4 If you want to put the display to sleep before the whole computer, drag the bottom slider to set the timing for putting the display to sleep.
5 To put the computer's hard disk to sleep whenever it's inactive, select the checkbox labeled "Put the hard disk(s) to sleep when possible."
6 To wake your computer from sleep, press a key on the keyboard or click the mouse.

Additional notes for Mac users:

To set a daily schedule for putting your computer to sleep (or turning it off and on), click Schedule and configure using the available options.

You can set more detailed options for waking and restarting your computer in the Options pane of Energy Saver preferences.

On iBooks and PowerBooks, the computer automatically sleeps when you close the lid. On iMacs and other desktop models, briefly pushing the power button will put the computer to sleep (unless this has been changed in the Options tab).

For more information about putting your computer to sleep, click the "?" button.

PCs (Windows XP)

To automatically put your computer on standby:

1. Click **Start**, click **Control Panel**, and then double-click **Power Options**.
2. In **Power Schemes**, click the down arrow, and then select a power scheme. The time settings for the power scheme are displayed in **Turn off monitor**, **Turn off hard disks, and System standby**.
3. To turn off your monitor before your computer goes on standby, select a time in **Turn off monitor**.
4. To turn off your hard disk before your computer goes on standby, select a time in **Turn off hard disks**.

PUTTING YOUR COMPUTER TO SLEEP (CONT'D)

Additional notes for PC users:

- You might want to save your work before putting your computer on standby. While the computer is on standby, information in computer memory is not saved to your hard disk. If there is an interruption in power, information in memory is lost.
- To create a new power scheme, specify the time settings you want, and then click **Save As**.
- If you're using a portable computer, you can specify one setting for battery power and a different setting for AC power.
- To put your computer on standby, you must have a computer that is set up by the manufacturer to support this option.
- Using Power Options in Control Panel, you can adjust any power management option that your computer's unique hardware configuration supports. Because these options may vary widely from computer to computer, the options described may differ from what you see. Power Options automatically detects what is available on your computer and shows you only the options that you can control.

ENERGY AUDIT SUMMARY

Name: ____

Date: ____

Facility/Room: ____

Item	**Findings** ***(identify the problem, e.g. room is overlit)***	**Recommendations** ***(rank from highest to lowest priority)***	**Cost Savings** ***(if applicable)***
Lighting			
Plug Loads			
Building Envelope			
Heating & Cooling Equipment			
Behaviors & Energy Controls			