



MFVI Energy Efficiency Audit Training

Module 2.2: Plug Loads Analysis

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Introduction to MFVI

MiPyMEs Futuros Verdes Initiative (MFVI) advances clean, reliable, and affordable energy solutions for micro-, small-, and medium-sized businesses (Spanish acronym “MiPyMEs”) in the Yucatan Peninsula through targeted technical training and affordable financial support. MFVI aims to increase financial inclusion, maximize the energy cost savings available to MiPyMEs, empower business owners to make strategic energy investments, and catalyze economic growth within the MiPyMEs sector.

The following modules were developed as part of a two-part targeted training series to equip university students with the skills and expertise needed to conduct Level-2 energy audits for local MiPyMEs. This module was designed for undergraduate students from different backgrounds to perform audits in small and micro business buildings. The energy savings measures will reflect this overall purpose.

What Is the Purpose of MFVI?



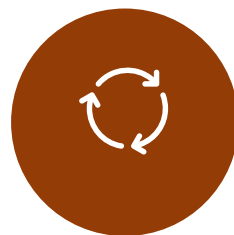
Help MiPyMEs implement energy efficiency



Determine simple energy conservation measure (ECM) savings through targeted energy efficiency audits



Enable MiPyMEs to qualify for affordable “green” loans

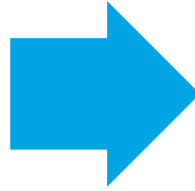


Begin a cyclical process of building green credit

MFVI Two-Part Training Process

Phase 1 Training

- Understand and measure energy efficiency via on-site audits



Phase 2 Training

- Conduct analysis of data collected during audits, and recommend ECMs

Training Breakdown

Module 1: Lighting

- 1.1 Introduction to Efficient Lighting
- 1.2 Lighting Analysis

Module 2: Plug Loads

- 2.1 Introduction to Plug Loads
- 2.2 Plug Load Analysis

Module 3: HVAC

- 3.1 Introduction to Cooling Systems
- 3.2 HVAC Analysis

Plug Load Analysis

Training Module 2.2



What You'll Need for the Analysis

- A copy of your field tool sheet with all information collected during audits
- A copy of the ENERGY STAR® payback calculator provided
- A copy of the equipment payback calculator provided.

Before We Start: Review the Equipment Data You Have Collected

- What are the plug loads with the highest wattages?
- Which plug load numbers are the highest?
- Which plug loads are used the most in a day?

Start calculating payback for the plug loads that you think consume the most energy. This is good practice in the industry if you have limited time.

Recommend Simple ECMs With Payback Periods

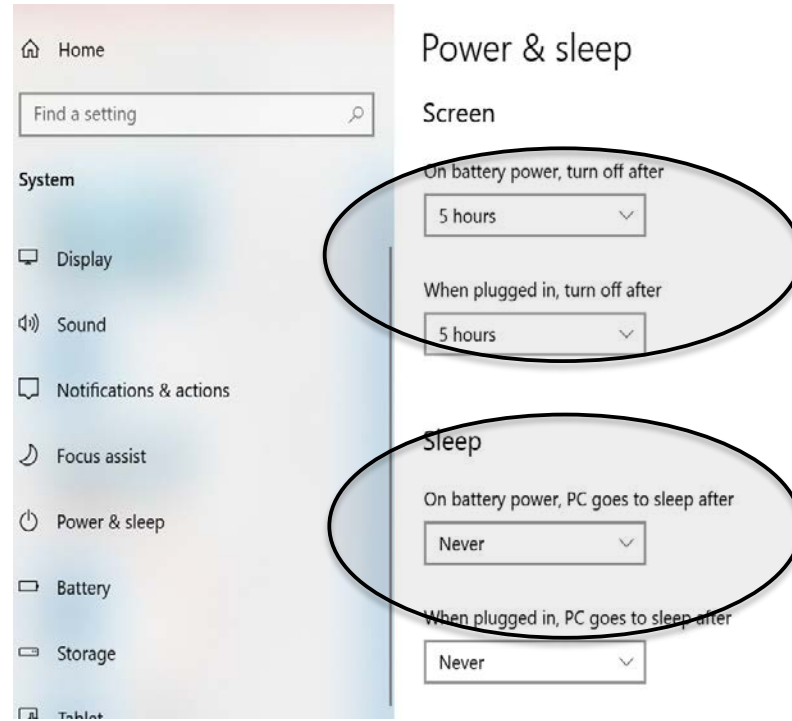
Computer settings



Step 1: Power and Sleep Settings

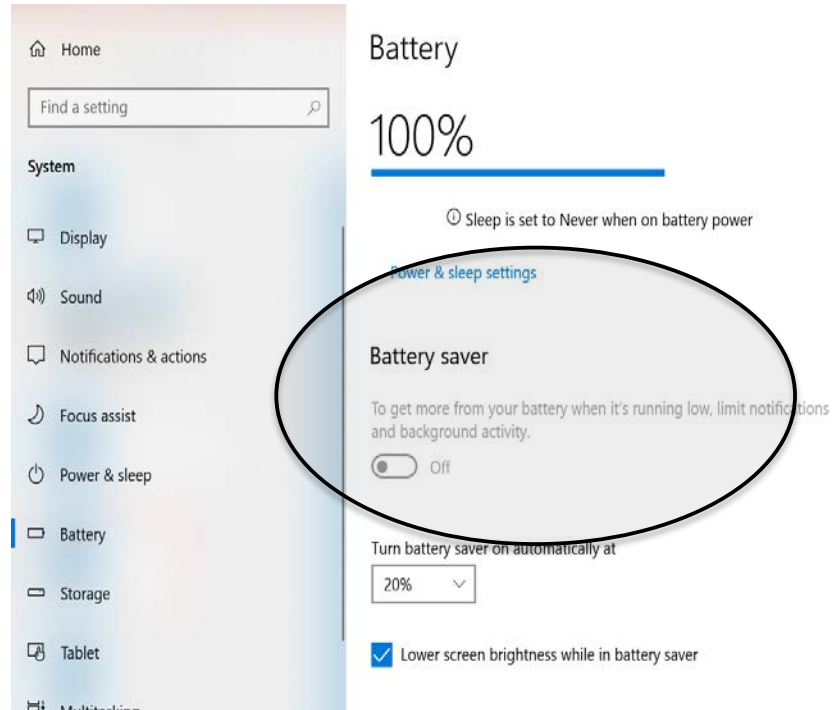
Set:

- “Turn off screen” to 5 minutes
- “Sleep” to 10 mins
- “Turn off hard disk” to 10 mins.



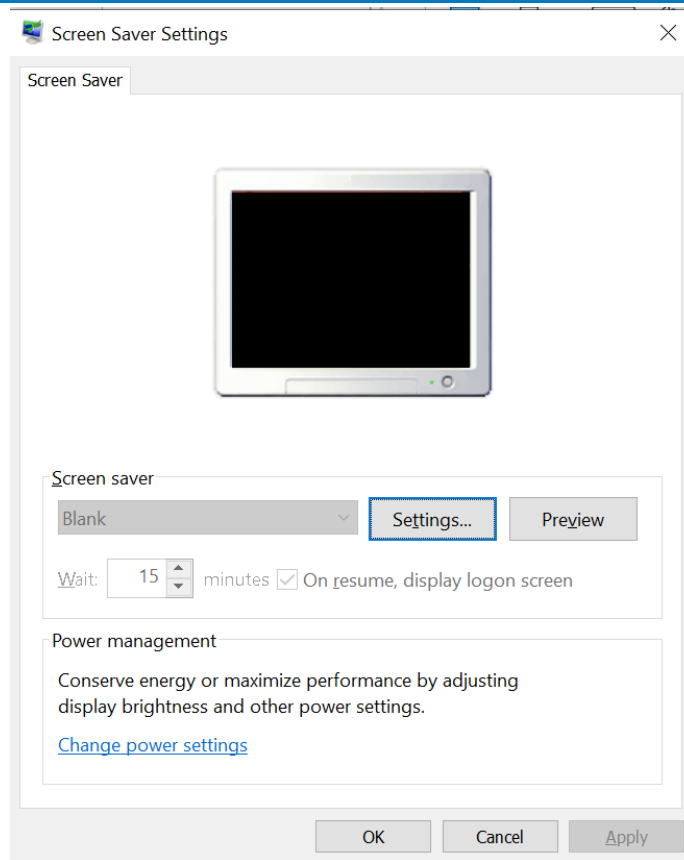
Step 2: Battery Settings

Activate “power saver mode.”



Step 3: Screen Saver Settings

Turn off screen saver settings. Use the search button to navigate to the screen saver settings page.



Step 3: Calculate Energy Saved Using the ENERGY STAR Payback Calculator

Use the circled link to access the ENERGY STAR page.

- Click the “Calculate your potential savings” tab, as shown
- This will download the “LowITcarbonsavings” calculator sheet.
- The sheet has four main tabs: “Start here,” “Adjust-power draw,” “Adjust-sleep settings,” and “Adjust-usage patterns.”
- The “Results” tab reflects results for the changes made in the four tabs.

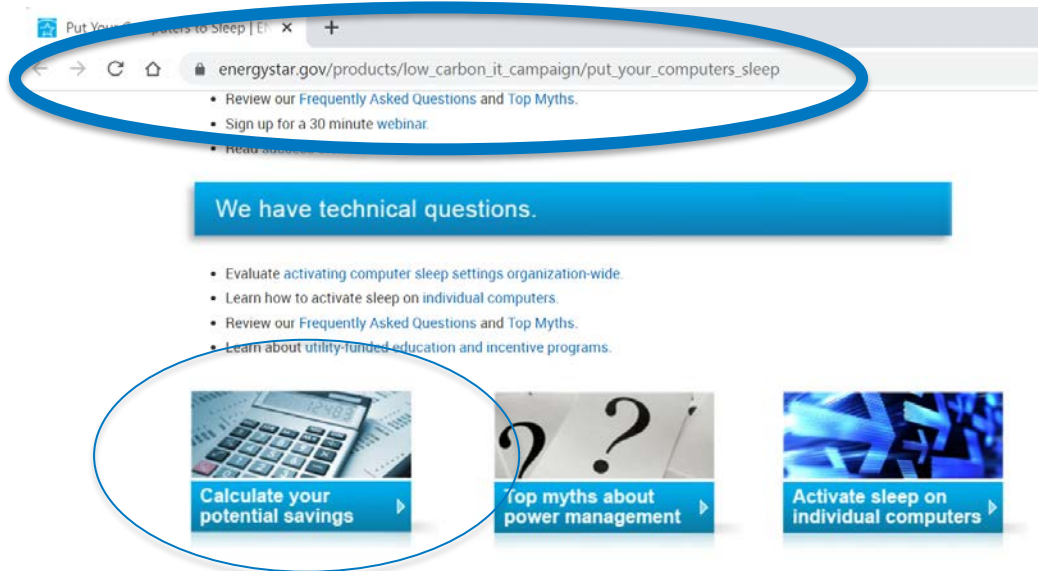


Image by [energystar.gov](https://www.energystar.gov)

Navigating the Payback Calculator: “Start here” tab

- Input the number of desktop computers, monitors, notebooks and displays in the required fields
- For electricity rate, **enter the rate directly into the yellow box provided.** The dropdown has information only for U.S. states.
- For turn-off rate, assume 70% as default.

ENERGY STAR Computer Power Management Savings Calculator

Instructions: Use this simple calculator to estimate typical savings from activating power management features that automatically place computers into a low-power "sleep" mode after a period of inactivity (required fields in red).

Number of Devices with Power Management Features Enabled

1) Enter the number of desktop computers	-
2) Enter the number of desktop monitors	-
3) Enter the number of notebook computers	-
4) Enter the number of notebook displays	-

Key Assumptions

5) **ELECTRICITY COST:** Select your state (or use the national average) and specify commercial or residential service; an electricity rate (\$/kWh) will be displayed in the yellow box. If you prefer, you can enter your own electricity rate in the yellow box.

6) **TURN OFF RATE:** Select your best estimate of the percentage of computers that users turn off manually each night.**

National Average
Commercial
36%

\$0.1232

Start Here Adjust - sleep settings Adjust - power draw Adjust - usage patterns Results

Image by energystar.gov

Navigating the Payback Calculator: Adjust Sleep Settings

- Change the options circled to 10 minutes each
- The time taken before the systems go to sleep/standby is determined from Module 2.1.

ENERGY STAR Computer Power Management Savings Calculator

What power management settings?

Instructions: Enter the settings you intend to use on monitors and computers. The defaults are set to 15 minutes for monitors/displays and 30 minutes for computers. The lower the setting, the more energy you save.*

		Minutes
Monitors:	1) Monitors enter low-power sleep mode after how many minutes of inactivity?	10
	Computers: 2) Computers enter system standby or hibernate mode after how many minutes of inactivity?	10
Displays/Screens:	3) Displays enter low-power sleep mode after how many minutes of inactivity?	10
	Computers: 4) Computers enter system standby or hibernate mode after how many minutes of inactivity?	10

After completing this page, click the **green "Results" tab** below to view your estimated savings **OR** use the other **red "Adjust" tabs** below to perform customized calculations specific to your environment.

Image by energystar.gov

Navigating the Payback Calculator: Adjust Power Draw

It is not recommended to change the values in this tab, unless there is specific information required to change this.

ENERGY STAR Computer Power Management Savings Calculator
How much power do monitors and computers use?

Instructions: Enter the amount of power your desktops and notebooks consume in sleep and idle mode. The values used are for a typical business computer. *

		Watts
Desktop Monitors:	1) Enter the power consumed in idle mode	34.9
	2) Enter the power consumed in sleep mode	2.0
	3) Enter the power consumed when shut off	1.0
Desktop Computers:	4) Enter the power consumed in idle mode	48.1
	5) Enter the power consumed in sleep mode	2.3
	6) Enter the power consumed when shut off	1.0
Notebooks (both display and computer)**	7) Enter the power consumed idle mode	14.8
	8) Enter the power consumed in sleep mode	1.2
	9) Enter the power consumed when shut off	0.6

After completing this page, click the **green "Results" tab** below to view your estimated savings OR use the other **red "Adjust" tabs** below to perform customized calculations specific to your environment.

Image by energystar.gov

Navigating the Payback Calculator: Adjust Usage Patterns

- This tab would be populated by information obtained on work schedules from Lighting Audit 1.1.
- Leave the discount rate at 4.0%.

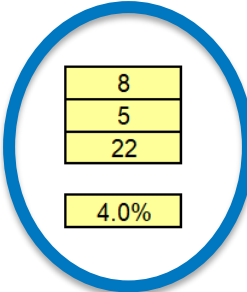
ENERGY STAR Computer Power Management Savings Calculator

How are your PCs used?

Instructions: Enter information about your organization.

- 1) How many **hours** in a typical workday in your organization?
- 2) How many **days** in a typical work week in your organization?
- 3) How many **non-working days per year** are typical for your organization? E.g., vacation days, sick days, holidays, etc.?
- 4) What **(real) discount rate** do you want to use in calculating 3-years savings?

After completing this page, click the **green "Results" tab** below to view your estimated savings OR use the other **red "Adjust" tabs** below to perform customized calculations specific to your environment.



8
5
22
4.0%

Navigating the Payback Calculator: Results

- The Results tab gives you an annual energy savings and cost savings over the year.
- It also offers dollar savings over 3 years, keeping in mind the discounted rate.
- It is also useful to look at the CO2 emissions prevented, although it is out of the scope of today's module.

ENERGY STAR Computer Power Management Savings Calculator						
Savings Estimate						
	Annual Savings		\$ Dollar Savings	3-Year Totals		
	Energy (kWh)	Dollars (\$)		Pollution Prevention Equivalents:		
				Tons of CO2 Emissions Prevented	Acres of trees planted	Number of cars removed
Savings from desktop monitors going into sleep mode:	2,607.8	\$321.28	\$891.59	6.0	4.48	1.15
Savings from notebook displays going into sleep mode:	359.5	\$44.29	\$122.90	0.8	0.62	0.16
<i>Total savings from monitor/display sleep mode</i>	<i>2,967.3</i>	<i>\$365.57</i>	<i>\$1,014.49</i>	<i>6.9</i>	<i>5.10</i>	<i>1.31</i>
Savings from desktop computers going into sleep mode:	3,629.1	\$47.10	\$1,240.76	8.4	6.23	1.60
Savings from notebook computers going into sleep mode:	359.5	\$44.29	\$122.90	0.8	0.62	0.16
<i>Total savings from computer sleep mode</i>	<i>3,988.6</i>	<i>\$91.39</i>	<i>\$1,363.66</i>	<i>9.2</i>	<i>6.85</i>	<i>1.76</i>
Total savings :	6,955.9	\$856.96	\$2,378.15	16.1	11.95	3.07

Navigating the Payback Calculator: Notes

- The ENERGY STAR savings calculator is based on a comprehensive study done on power draws of a computer on different modes.
- This can be used to report out final payback periods to customers.
- Click any of the tabs and “Unhide” worksheets to look at calculations, if needed.

		COMPUTERS				NOTEBOOKS				
		Setting	Monitor	Computer		Screens	Computer			
		10	10	10	10	10	10	10	10	
Time	Activity	Computer in use?	Time On	Time Sleep	Time On	Time Sleep	Time On	Time Sleep	Time On	Time Sleep
8:30	Power on									
1/0/1900 8:45	Check email	Y	15	0	15	0	15	0	15	0
1/0/1900 9:00	Telephone calls	15	10	5	10	5	10	5	10	5
1/0/1900 9:15		30	0	15	0	15	0	15	0	15
1/0/1900 9:30		45	0	15	0	15	0	15	0	15
1/0/1900 9:45	Check e-mail	Y	15	0	15	0	15	0	15	0
1/0/1900 10:00	Meeting	15	10	5	10	5	10	5	10	5
1/0/1900 10:15		30	0	15	0	15	0	15	0	15
1/0/1900 10:30		45	0	15	0	15	0	15	0	15
1/0/1900 10:45		60	0	15	0	15	0	15	0	15
1/0/1900 11:00	Draft paper	Y	15	0	15	0	15	0	15	0
1/0/1900 11:15		Y	15	0	15	0	15	0	15	0
1/0/1900 11:30	Walk-in meeting	15	10	5	10	5	10	5	10	5
1/0/1900 11:45		30	0	15	0	15	0	15	0	15
1/0/1900 12:00	Lunch	45	0	15	0	15	0	15	0	15
1/0/1900 12:15		60	0	15	0	15	0	15	0	15
1/0/1900 12:30		75	0	15	0	15	0	15	0	15
1/0/1900 12:45		90	0	15	0	15	0	15	0	15
1/0/1900 13:00	Computer Work	Y	15	0	15	0	15	0	15	0
1/0/1900 13:15		Y	15	0	15	0	15	0	15	0
1/0/1900 13:30		Y	15	0	15	0	15	0	15	0
1/0/1900 13:45		Y	15	0	15	0	15	0	15	0
1/0/1900 14:00	Meeting	15	10	5	10	5	10	5	10	5
1/0/1900 14:15		30	0	15	0	15	0	15	0	15
1/0/1900 14:30		45	0	15	0	15	0	15	0	15

Applied Student Exercise

Let's calculate the payback for all the computers in one building! 😊

Recommend Simple ECMs With Payback Periods

Replace existing equipment with ENERGY
STAR equipment



Step 1: Calculate Annual Energy Use and Annual Energy Cost of the Plug Loads in a Space

For each space in the building, input the following values into the payback calculator provided:

- Space name
- Plug load name and type
- Number of plug loads of the particular type
- Wattage
- Weekday and weekend hours of operation.

The payback calculator will then calculate the annual energy use and energy cost of the lights in that particular space. Refer to the payback calculator for more information on how to calculate energy use and costs.

Notes

- If you don't have the wattage of a plug load, try googling the model # to get a wattage of the product.
- If you used a modern watt meter to measure a load's energy use in kWh, directly enter the annual energy use of the load in the appropriate tab in the payback calculator.

Step 2: Look up Alternate Products for Plug Loads

- For each load, use the [ENERGY STAR](#) website to look for certified low-efficiency products.
- Navigate through filters to find the most similar product to the one being replaced.

Step 2: Look up Alternate Products for Plug Loads

The screenshot shows the ENERGY STAR website interface. At the top left is the ENERGY STAR logo. To its right is a navigation menu with links for 'Find Products', 'Save at Home', 'New Homes', 'Commercial Buildings', and 'Industrial Plants'. A blue circle highlights the 'Find Products' link, and a blue arrow points from it to a search bar in the top right corner, which is also circled in blue. Below the navigation is a section titled 'Energy Efficient Products for Consumers' with a sub-header 'Home » Energy Efficient Products for Consumers'. The text below this section explains that users can find rebates and retailers for ENERGY STAR certified products. To the right of this text are two buttons: 'See A Full List Of Products' and 'See Energy Efficient Products For Businesses'. Below this is a 'Heating & Cooling' section with links for 'Air-Source Heat Pumps' and 'Boilers', and three product images. The main content area is divided into several product categories, each with a list of items:

- Appliances**
 - Air Purifiers (Cleaners)
 - Dehumidifiers
 - Residential Clothes Dryers
 - Residential Clothes Washers
 - Residential Laundry Center
 - Residential Combination All-in-One Washer-Dryer
 - Residential Dishwashers
 - Residential Freezers
 - Residential Laundry Sets
 - Residential Refrigerators
- Building Products**
 - Storm Windows
 - Windows, Doors, & Skylights
 - NFRC Directory [EXIT](#)
- Data Center Equipment**
 - Data Center Storage
 - Enterprise Servers
 - Large Network Equipment
 - Small Network Equipment
 - Uninterruptible Power Supplies
- Heating & Cooling**
 - Boilers
 - Central Air Conditioners
- Office Equipment**
 - Computers
 - Displays
 - Imaging Equipment
- Other**
 - Electric Vehicle Chargers
 - Lab Grade Refrigerators and Freezers
 - Pool Pumps
 - Vending Machines
 - Water Coolers
- Water Heaters**
 - Commercial Water Heaters
 - Water Heaters
- Electronics**
 - Audio/Video
 - Set-Top Boxes
 - Telephones
 - Televisions

Photo by [energystar.gov](https://www.energystar.gov)

Step 2: Look up Alternate Products for Plug Loads

14,521 MONITORS Found

Filter Your Results

filter by keyword

Product Type

- Monitor (962)
- Signage Display (481)
- Do not filter

Screen Size (inches)

- 0 - 14.9 (15)
- 15 - 17.9 (25)
- 18 - 21.9 (166)
- 22 - 25 (357)
- 25.1 - 31.9 (345)
- 32 and up (534)

ENERGY STAR Most Efficient

- Most Efficient (105)

Sort by:

Total Energy Consumption (kWh/yr) ↑↓

Share

ASUS - MB16A

Monitor - 15.6 Inches

On Mode Power (watts): 3.64 watts

Total Energy Consumption (kWh/yr): 11.45 kWh/yr

Panel Type: TFT LCD

Sleep Mode Power (watts): 0.05 watts

Native Resolution (pixels): 1080 x 1920

CLICK FOR PRODUCT DETAILS

JAXJOX® - JJ15003

Signage Display - 42.5 Inches

On Mode Power (watts): 69.73 watts

Total Energy Consumption (kWh/yr): 11.62 kWh/yr

Panel Type: IPS LCD

Sleep Mode Power (watts): 0.93 watts

Native Resolution (pixels): 3840 x 2160

CLICK FOR PRODUCT DETAILS

HP - HP E14 G4

Monitor - 14.0 Inches

On Mode Power (watts): 3.8 watts

Panel Type: TFT LCD

Sleep Mode Power (watts): 0.2 watts

energystar.gov/productfinder/product/certified-displays/details/2393282

ASUS - MQ16A

PDF OPEN DOWNLOAD


Description	Size
Product Type:	Monitor
Panel Type:	OLED
Maximum Luminance (candelas per square meter):	400.0
Power Source:	USB
Efficiency	
Monitor Total Energy Consumption at 115 Volts (kWh/yr):	17.6
On Mode Power (watts):	4.84
Sleep Mode Power (watts):	0.47
Screen Size (inches):	15.6
Screen Area (square inches):	103.3
Native Resolution (pixels):	1920 x 1080
Total Native Resolution (megapixels):	2.1
Features	
Model Features:	None
Signal or Data Interfaces:	HDMI,USB
ENERGY STAR Certified:	Yes
Most Efficient:	

Photo by [energystar.gov](https://www.energystar.gov)

Step 3: Calculate Annual Energy Savings, Cost Savings, and Simple Payback

- Note the product's annual energy use in the plug loads payback calculator to calculate annual energy and cost savings.
- The calculator will also calculate a simple payback period.

Let's Do the Math!

For each type of lamp in every space in the building, the following are calculated:

1 **Annual Hours of Usage**
= (weekday hours of use * 260 weekdays per year)
+ (weekend hours of use * 100 weekends per year)

2 **Annual Energy Use (kWh)**
=
$$\frac{(\text{Annual Hours of Usage} * \text{lamp wattage (W)} * \text{number of loads})}{1000}$$

3 **Annual Energy Cost (USD)**
= Annual Energy Use (kWh) * electricity tariff rate ($\frac{\$}{\text{kWh}}$)

Let's Do More Math!

- 1 Annual Energy Cost Savings (kWh)**
= energy cost of existing lamp – energy cost of replacement lamp
- 2 Labor Cost** = labor rate per hour (\$) * Number of hours
- 3 Total Cost Savings (\$)**
= Annual Energy Cost Savings – total labor costs – procurement costs of lamps
- 4 Simple payback ratio** = Total Cost ÷ Total Cost Savings

A payback of 0-2 years is generally considered good for lighting ECMs.

Using the Payback Calculator

Summary Metrics	
Total energy savings (kWh)	3870
Energy cost savings (\$/yr)	658
Total number of loads	5
Total lamp procurement costs (\$)	25
Total labor costs (\$)	0
Total cost savings (\$)	633
Simple payback	0.04

The payback calculator can be used to calculate key financial metrics such as annual energy cost savings (in \$) and simple payback periods for implementing a specific ECM.

Plug Loads ECM Analysis

This is a simple payback calculator. It takes into account the total energy cost savings over a year due to changing plug load devices, and calculates a simple payback. Row 13 provides an example.

Summary Metrics	
Total energy savings (kWh)	3870
Energy cost savings (\$/yr)	658
Total number of fixtures	5
Total lamp procurement costs (\$)	25
Total labor costs (\$)	0
Total cost savings (\$)	633
Simple payback	0.04

Space Load Details

Space name	Load name	Load type (vending machine, refrigerator, etc.)	Number of loads	Watts	Weekday hours per day
Load type 1	VM-1234	Vending machine	1	50	10
Load type 2	VM-3456	Vending machine	2	50	10

Applied Student Exercise

Let's use the payback calculator to calculate annual energy use and costs of the loads in one of your spaces in the building! 😊

Pause and Recap

Questions?



Recommend Simple ECMs With Payback Periods

Removing unwanted equipment




Removing Extraneous Loads in the Space

- Look at A3 for all the extraneous plug loads you have documented in the building
- If the plug loads will not be noticeable when removed, remove the equipment.
- Remember that employees are priority! If they do not recommend removing equipment, DO NOT do it!



Calculating Energy and Cost Savings for Removing Loads

- To calculate energy and cost savings for removing a load, simply enter the replacement load and procurement costs as 0 in the respective columns in the spreadsheet.
 - Note that labor costs will remain non-zero.



Replacement Load Metrics			Energy efficiency metrics		Total Savings		Total Costs		
Replacement load wattage	Replacement load cost	Watt-hours per year for replacement	Annual energy use after replacement (kWh)	Annual energy cost (\$/yr)	Annual energy use savings (kWh/yr)	Energy cost savings (\$/yr)	Load procurement cost (\$)	Labor costs (\$)	Net costs (\$)
20	\$ 5.00	52,000	52	\$ 8.84	78	\$ 13.26	\$ 5.00		\$ 8.26
20	\$ 5.00	104,000	104	\$ 17.68	2,396	\$ 407.32	\$ 10.00		\$ 397.32
0	\$ -	-	-	\$ -	1,500	\$ 255.00	\$ -		\$ 255.00
0	\$ -	-	-	\$ -	-	\$ -	\$ -		\$ -

Pause and Recap

Questions?



Recommend Simple ECMs With Payback Periods

Other measures



Other Measures To Consider: Replace Desktop Computers With Laptops

- Laptops consume 50%-80% less electricity than desktop computers, as they operate on a battery.
- Laptops cost between \$1,000 to \$2,000, so calculate payback accordingly.

Computer Type	Processor Type	Active/On (Watts)	Suspended (Watts)	Off (Watts)
Docked Laptop w/ LCD	Intel Core	62	3	3
Desktop w/ LCD	Intel Core	115	6	3.5
Desktop w/CRT	Intel Core	145.25	16	7

Other Measures To Consider: Vending Misers

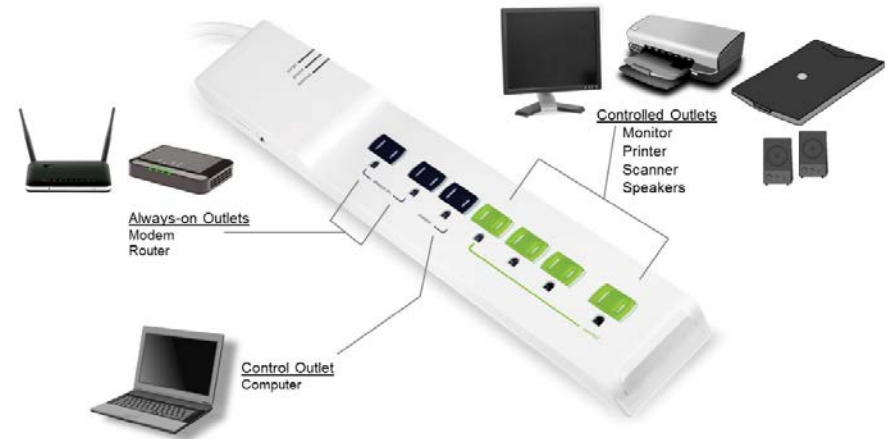
- Misers are devices that are attached to a vending machine.
- They help turn off the machine when not in use, monitor the room temperature, and regulate cooling energy required by the system.
- They save an average of 45% electricity per year.
- They cost \$165 per unit.



Photo by tufts.edu

Other Measures To Consider: Advanced Power Strips

- Advanced power strips help monitor the energy use of loads and shut off power to devices when the device is switched off.
- They save between 15%-25% electricity per year.
- They cost \$35-60 per strip




Refer to [this link](#) for more information on which power strips are right for you.

Photo by masssave.com

Other Measures To Consider: Advanced Power Strips (cont.)

ADVANCED POWER STRIPS
Which one is right for me?



I want to stop **WASTING ENERGY** in my...

ENTERTAINMENT CENTER
I always turn off my electronics when done

Why don't I turn them off? **No** **Yes**

Do I want manual or automated power control?


I fall asleep | I forget | I'll do it myself | Automatic

HOME OFFICE
Is the computer a laptop or tablet?


Do I put it to sleep, or shut down? **No** **Yes**

Does it stay docked or is it frequently moved?


Sleep | Shut down | Always docked | Moved often




Timer Power Strip




Activity Monitor Power Strip



Remote Switch Power Strip



Master-Controlled Power Strip



Masterless Power Strip

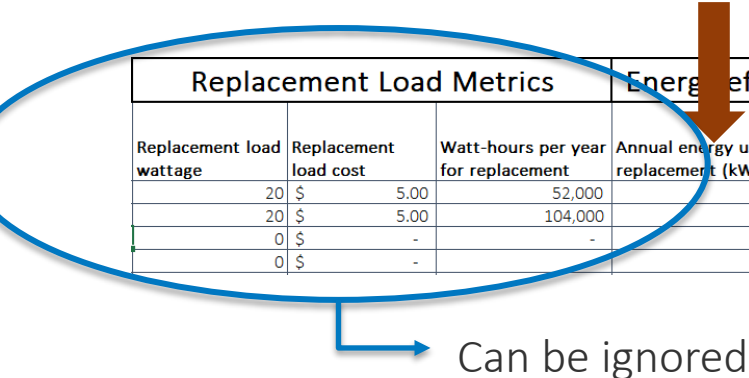
	Timer Power Strip	Activity Monitor Power Strip	Remote Switch Power Strip	Master-Controlled Power Strip	Masterless Power Strip
COST	\$	\$	\$	\$	\$
FEATURES	Power strip automatically turns off outlets based on a pre-set schedule.	Power strip looks for signs of activity in the room, and turns off outlets if none is detected.	Power strip can be turned off by the user via a remote switch.	When a primary device (such as a computer or TV) is turned off by the user, the power strip automatically turns off the controlled outlets where the peripheral devices (such as the printer or game console) are plugged in.	When all of the controlled devices are turned off, the power strip turns off power to these outlets completely, eliminating all of the vampire loads.
POSSIBLE DRAWBACKS	You have to set up the timer and stick to your schedule for maximum energy savings.	Motion sensors don't always work perfectly.	To save any energy, you have to remember to turn off the power strip each time.	It can be tricky to select which appliance should be your "master" device.	Turning off one high-powered appliance could turn off the entire power strip.
WHAT TO LOOK FOR	Digital or dial timer.	Motion sensor or an infrared "eye" that detects remote control use around the TV or stereo.	A labeled switch or a remote switch.	One outlet is labeled as the "master".	No "master" outlet. Description may include "automatic switching" or "vampire detection".

- Advanced power strips help reduce vampire loads
- Vampire load is the electricity consumed when we have devices on standby mode, or if we forget to turn them off.

Photo by nrel.gov

Calculating Energy and Cost Savings for These Other Measures

- Use the “Percentage energy savings assumption” tab to get a percentage reduction value for the measure being recommended.
- Calculate the energy use after reduction and directly enter this number into the “Annual energy use after replacement” tab in the “Energy efficiency metrics” section.



Replacement Load Metrics			Energy efficiency metrics		Total Savings		Total Costs		
Replacement load wattage	Replacement load cost	Watt-hours per year for replacement	Annual energy use after replacement (kWh)	Annual energy cost (\$/yr)	Annual energy use savings (kWh/yr)	Energy cost savings (\$/yr)	Load procurement cost (\$)	Labor costs (\$)	Net costs (\$)
20	\$ 5.00	52,000	52	\$ 8.84	78	\$ 13.26	\$ 5.00		\$ 8.26
20	\$ 5.00	104,000	104	\$ 17.68	2,396	\$ 407.32	\$ 10.00		\$ 397.32
0	\$ -	-	-	\$ -	1,500	\$ 255.00	\$ -		\$ 255.00
0	\$ -	-	-	\$ -	-	\$ -	\$ -		\$ -

Can be ignored

Applied Student Exercise

Assume a building has 15 desktop computers and 4 vending machines. Calculate the energy use and cost savings with:

- Replacing all the desktops with laptops
- Installing misers in vending machines.



Questions?

www.nrel.gov

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