Commercial - Mapping the Path to a Systems-Efficient Market

Miscellaneous Electric Loads (MELs)

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Agenda

1. **Introduction**

2. **Miscellaneous Electric Loads (MELs)**

1. Introduction

- The "System Efficiency RoadMap" 2017- System Efficiency Initiative by the Alliance to Save Energy covers 4 topics:

  1. **Key Building Systems and their Interactions**

  2. DC Power Distribution

  3. Grid-Edge and District Energy Systems

  4. Cross-Cutting Strategies

- MELs is one of the topics covered in **Key Building Systems and their Interactions**

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2. Miscellaneous Electric Loads (MELs)

What are Miscellaneous Electric Loads (MELs)?

- Miscellaneous electric loads (MELs) in commercial buildings, also often referred to as "plug" or "process" loads, are electric loads not related to HVAC&R or lighting systems.

- MELs encompass a vast array of devices, ranging from computers, data center servers, and elevators to security systems and medical equipment.

- MELs can be classified as "Defined" and "Undefined"

  - ❖ "Defined" = MELs that are characterized by the Energy Information Administration (EIA) for the Annual Energy Outlook (AEO)

  - ❖ " Undefined" = MELs that have not been specifically characterized by EIA/AEO/NEMS (around 58% of the total commercial MELs)

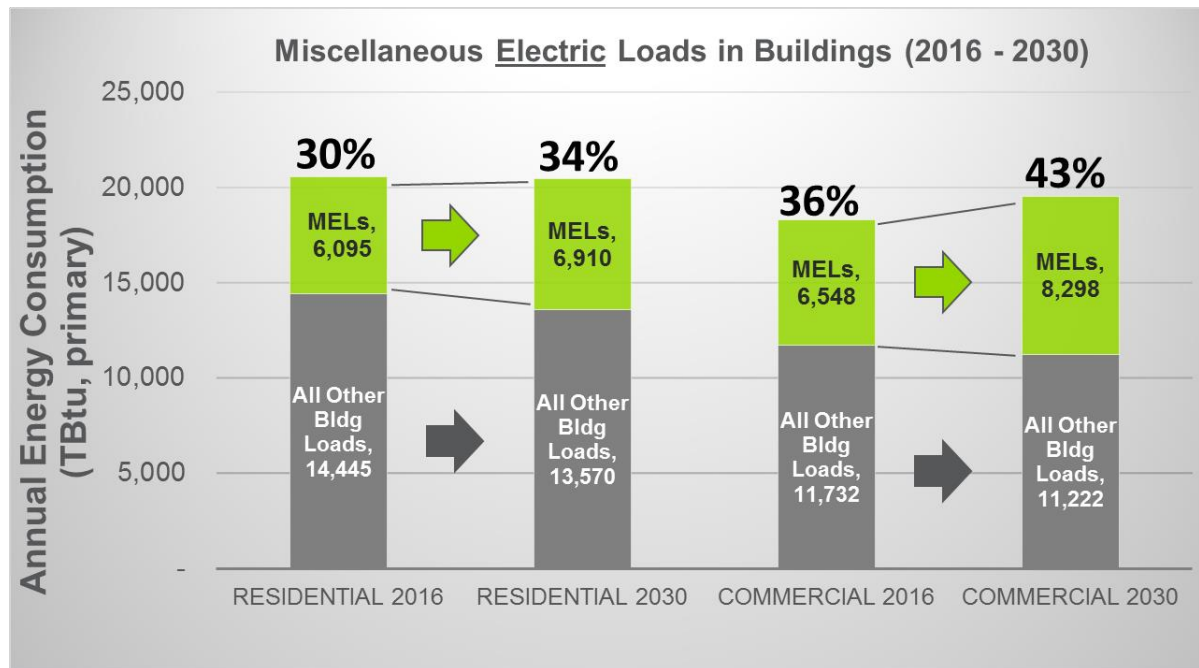Johnson Controls

2. Miscellaneous Electric Loads (MELs)

Annual Energy Outlook (AEO) Category	Further Breakdown
Non-PC office equipment*	Servers (not in data centers)
	Printers
	Servers (data centers)
	Copiers
	Multi-function devices
	Fax machines
	Scanners
Municipal water services#	Water distribution & purification
	Wastewater treatment
PC office equipment+	Desktop PCs
	Monitors
	Laptop PCs
Other "undefined" MELs*	Mobile phone towers#
	Irrigation#
	Slot machines
	Automated teller machines
	Arcades
	Fitness equipment

Source: DOE/BTO RFI DE-FOA-0001631

2. Miscellaneous Electric Loads (MELs)

How much energy do MELs consume?

- MELs are responsible for approximately **25%** of the total electrical load in a minimally code-compliant commercial building; in a high efficiency building this percentage can be higher than **50%**

- MELs in commercial buildings are expected to increase from **36% to 43%** from 2016 to 2030

Miscellaneous <u>Electric</u> Loads in Buildings (2016 - 2030)

Source: DOE/BTO RFI DE-FOA-0001631:
http://energy.gov/eere/buildings/downloads/bto-investigates-miscellaneous-electric-loads

2. Miscellaneous Electric Loads (MELs)

- Commercial MELs Breakdown and Appliance Standards (2016)

Commercial Load/End-Use	2020 Primary Energy Consumption (TBtu)	DOE Appliance Standards: Current Status as of July, 2016	Energy Star Specification? (as of July, 2016)
Undefined MELs	3,970		
Non-PC office equipment*	718		Yes
Municipal water services#	681	DOE Standard for pumps requires compliance in 2020	
Kitchen ventilation	416		
Dry-type transformers	393	DOE Standard in effect	
PC office equipment*	203		Yes
Security systems	93		
Fume hoods	72		
Cooking equipment	67		
Video displays*	61		Yes
Lab refrigerators & freezers	43		
Coffee brewers	32		Yes
Medical imaging	31	DOE Standard in effect for motor	
Elevators	30		
Laundry equipment	14	DOE Standard in effect for commercial clothes washers	
Escalators	6		
Large video boards*	1		
Commercial MELs Total 2020 Primary Energy Use	6,831		

* For the electronics listed, DOE has standards for battery chargers and external power supplies which are part of the kWh.

\# Not within the scope of BTO, but still of interest to DOE

Source: DOE/BTO RFI DE-FOA-0001631 "Analysis and Representation of Miscellaneous Electric Loads in NEMS" 2013, https://www.eia.gov/analysis/studies/demand/miselec http://energy.gov/eere/buildings/appliance-and-equipment-standards-program

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2. Miscellaneous Electric Loads (MELs)
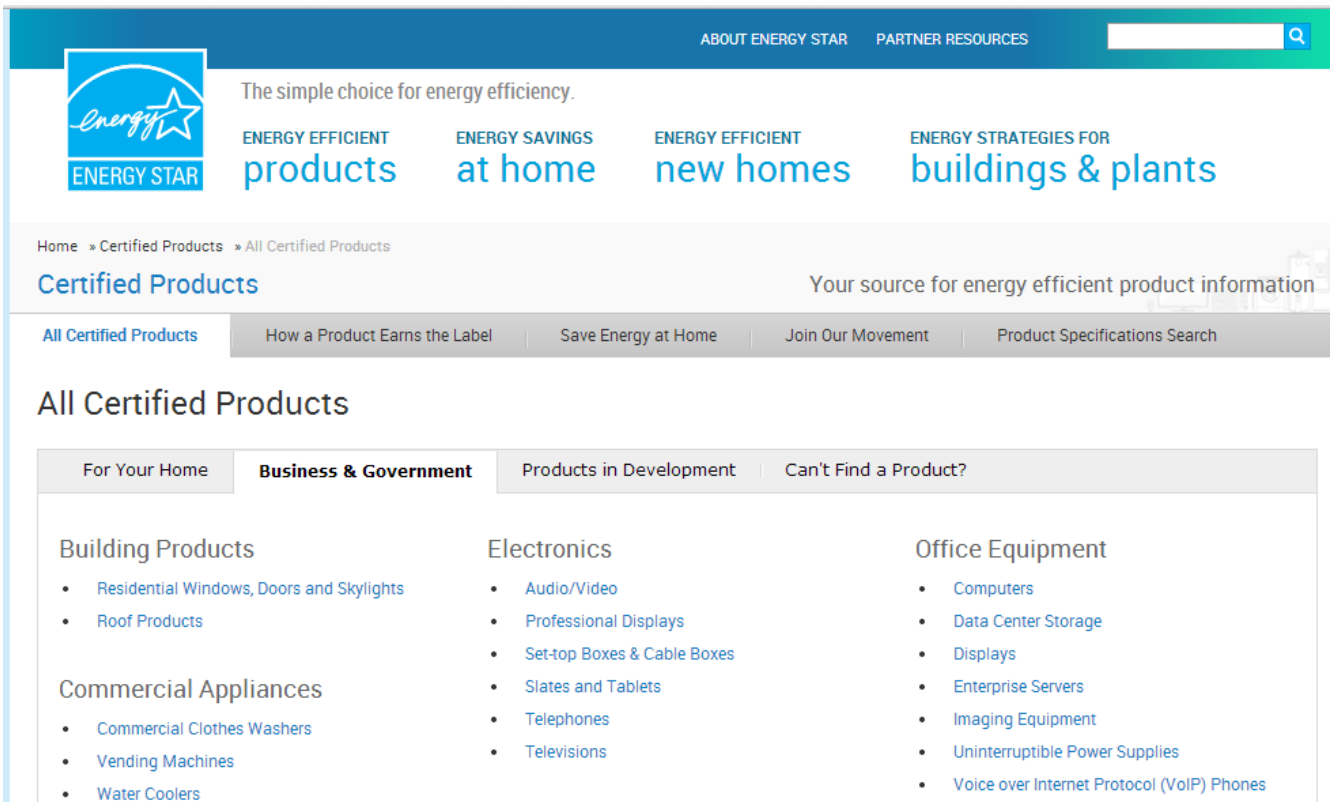
How can MELs energy use be reduced?

- MEL energy reduction can be achieved by:

    1. Technology-based solutions

    2. Occupant engagement / behavior

- There are several technology-based strategies to reduce MELs, which can be implemented independently or simultaneously:

    1. Energy reduction at the device level by improving MEL device efficiency

    2. Enhanced control of an individual MEL device to reduce power

    3. Integration of MEL device controls with system-level sensors and controls and with other building systems to optimize building operation.

2. Miscellaneous Electric Loads (MELs)

1. <u>Energy reduction at the device level by improving device efficiency</u>.

- Minimum Energy Performance Standards (MEPS) such as DOE (EnergyStar) and California Energy Commission.
- As of 2016, 39% of 41 MELs found to be EnergyStar (based on MEL list from Lobato et al. 2012).

2. Miscellaneous Electric Loads (MELs)

2. <u>Enhanced control of an individual/local MEL device</u>

- Local MEL control systems are typically performing the following (both manual or automatic):

    1. Transitioning the device to a low-power state

    2. De-energize the device to eliminate the power draw

- Six typical individual/local MEL controls:

    1. Built-In Automatic Low-Power State (Automatic)

    2. Scheduling (Automatic)

    3. Load Sensing (Automatic)

    4. Occupancy (Automatic)

    5. Manual ON-Vacancy OFF (Automatic and Manual)

    6. Manual Control (Manual)

- In some cases no control required.

Source: Lobato et al. 2012. ("Selecting a Control Strategy for Miscellaneous Electrical Loads," National Renewable Energy Laboratory, Technical Report NREL/TP-5500-51708 September 2012)

Device	Built-In Automatic Low-Power State	Scheduling	Load Sensing	Occupancy	Manual On, Vacancy Off	Manual Control	No Control
Audio equipment		X	X	X	X		
Battery chargers		X					
Cash registers		X		X	X		
Computer monitors	X		X				
Credit card machines	X		X				
Decorative lighting			X		X		
Desktop computers	X						
Digital photo frames			X		X		
Dishwashers		X					
Drinking fountains		X		X	X		
Electric hole punchers		X	X		X		
Electric information displays	X	X		X	X		
Electric pencil sharpeners		X	X		X		
Electric staplers		X	X		X		
Fans		X		X	X		
Floor cleaners		X			X	X	
Floor polishers		X			X	X	
Freezers							X
Gym equipment		X			X		
Heaters		X			X		
Label makers/printers		X	X		X		
Laptop computers	X		X				
Ovens/stoves/ranges		X					
Paper shredders		X	X		X		
Peripherals			X				
Personal print/copy equipment			X				
Phones	X						X
Projectors	X	X	X		X		
Refrigerators							X
Shared print/copy equipment	X	X					
Small kitchen appliances		X			X		
Smart boards		X			X		
Task lighting			X		X		
Televisions	X	X		X	X		
UPS units		X	X				
Vacuums					X	X	
Vending machine – nonrefrigerated		X		X			
Vending machine – refrigerated (parishable items)		X		X			X
Vending machine – refrigerated (non-parishble items)		X		X			
Water coolers		X		X	X		
Water filters		X		X	X		
Water heaters		X		X	X		

Source: Lobato et al. 2012. ("Selecting a Control Strategy for Miscellaneous Electrical Loads," National Renewable Energy Laboratory, Technical Report NREL/TP-5500-51708 September 2012)
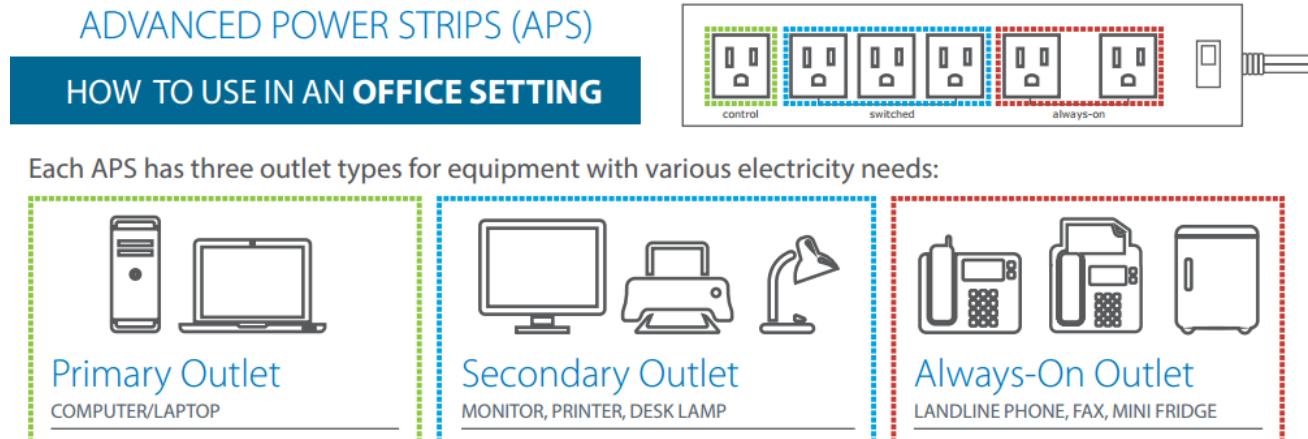
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2. Miscellaneous Electric Loads (MELs)

- **Example 1**: Load Sensing Control Device (Source: NREL)

ADVANCED POWER STRIPS (APS)

HOW TO USE IN AN OFFICE SETTING

control | switched | always-on

Each APS has three outlet types for equipment with various electricity needs:

Primary Outlet
COMPUTER/LAPTOP

Secondary Outlet
MONITOR, PRINTER, DESK LAMP

Always-On Outlet
LANDLINE PHONE, FAX, MINI FRIDGE

- **Example 2**: Occupancy and Schedule Device Control – (Receptacle Control)

  - Required by energy standards such as ASHRAE 90.1 & CA Title 24)

8.4.2 Automatic Receptacle Control

The following shall be automatically controlled:

a. At least 50% of all 125 V, 15 and 20 amp receptacles in all private offices, conference rooms, rooms used primarily for printing and/or copying functions, break rooms, classrooms, and individual workstations.

b. At least 25% of *branch circuit* feeders installed for modular furniture not shown on the *construction documents*.

(Source: ASHRAE 90.1-2016)

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2. Miscellaneous Electric Loads (MELs)

- Example of Energy Savings from Local Control:

		Printer	Laptop	Monitor	Under-Cabinet Light	Misc. Equipment	Kitchen Equipment	Total
Schedule timer	Edward A. Garmatz U.S. Courthouse	68%	13%	14%	14%	25%	13%	43%
	William J. Green, Jr. Federal Building	31%	54%	27%	34%	67%	79%	52%
Load-sensing	Robinson and Merhige Courthouse	69%	-4%	-6%	n/a	51%	n/a	23%
	Veteran Administration Building	-5%	16%	11%	0%	54%	n/a	10%
Both	Robert C. Byrd U.S. Courthouse	18%	35%	-2%	22%	40%	n/a	23%
	Cohen Complex	27%	14%	-1%	-1%	68%	n/a	12%
Average	Average	35%	21%	7%	14%	51%	46%	27%

(Source: Metzger et al. 2012. "Plug-Load Control and Behavioral Change Research in GSA Office Buildings")

2. Miscellaneous Electric Loads (MELs)

3. <u>Integration of MEL device controls with system-level sensors and controls and with other building systems</u>

- Currently available control systems for HVAC, lighting, etc. are well established. Similarly, the control of local MELs has progressed considerably in the last several years.

- However there is a lack of coordination among building systems (e.g., lighting , HVAC, MELs, etc.).

- Integrated control systems can provide additional energy savings.

- Example: CBERD: Integrated Sensors and Controls - LBNL (https://energy.gov/eere/buildings/downloads/cberd-integrated-sensorts-and-controls)

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2. Miscellaneous Electric Loads (MELs)

- Occupant Engagement / Behavior:

  - **Occupant training** to avoid disabling/overriding of controls.

  - **Work with IT to allow occupants to power down at night** (the degree to which people turn off equipment by hand).

  - **Establish effective energy policies**. The transition to the lowest power mode (standby) was found to save more energy than schedule-based control (effective on devices such as computers, monitors, copiers, and printers.)

2. Miscellaneous Electric Loads (MELs)

What are the recommendations?

1. Energy reduction at the device level by improving MEL device efficiency

   - **DOE** should continue to develop and update minimum efficiency requirements for new and existing MEL devices.

   - **State standard-setting bodies** should add minimum efficiency requirements for new and existing MEL devices to state standards, such as California Title 20 or standards proposed through the Multi-State Appliance Standards Collaborative.

(Source: Systems Efficiency Roadmap , 2017 - Alliance to Save Energy , Systems Efficiency Initiative)

2. Miscellaneous Electric Loads (MELs)

What are the recommendations?

2. <u>Enhanced control of an individual MEL device</u>

- **DOE** should analyze the economic feasibility of expanding to other states. California's code requirement that 50 percent of all electric receptacles have automated controls. Based on the results, consider recommending model code modifications including provisions for system-level, integrated controls.

- **ASHRAE** should add minimum requirements in building energy codes for control, monitoring, and tracking of local MEL equipment, such as local automatic receptacle control and internet-enabled electrical outlets and switches (i.e., smart wi-fi outlets and plugs).

(Source: Systems Efficiency Roadmap , 2017 - Alliance to Save Energy , Systems Efficiency Initiative)

2. Miscellaneous Electric Loads (MELs)

What are the recommendations?

3. <u>Integration of MEL device controls with system-level sensors and Building Management Systems</u>

- ***Manufacturers and manufacturer associations*** should work to enhance open-system protocols to facilitate the integration of MEL local controls with Building Management Systems (BMS) to optimize total building operation (e.g., using shared occupancy sensors to turn off or put in "sleep" mode computers, printers, lighting and/or zoned HVAC.

(Source: Systems Efficiency Roadmap , 2017 - Alliance to Save Energy , Systems Efficiency Initiative)

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2. Miscellaneous Electric Loads (MELs)

What are the recommendations?

4. <u>Development and generation of end-use data and MELs modeling procedures</u>

- ▪ ***DOE and ASHRAE*** should support the development of improved end-use data by undertaking case studies to compare savings and cost-effectiveness of MEL control methods for different categories of MELs.

- ▪ ***DOE and its national laboratories and ASHRAE*** should support the development of energy modeling data to more reliably predict system-level energy savings potential from MELs.

- ▪ ***DOE*** should carry out modeling and develop case studies related to occupant engagement in MEL control/reduction measures (with national laboratories and ASHRAE).

(Source: Systems Efficiency Roadmap , 2017 - Alliance to Save Energy , Systems Efficiency Initiative)

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Thank You