

A decorative graphic on the left side of the slide, consisting of a network of thin, light green lines and small circles, resembling a circuit board or a stylized tree structure.

# PLUG LOAD ENERGY EFFICIENCY CODES & STANDARDS: A POLICY REVIEW

PRESENTATION BY: KATIE GLADYCH

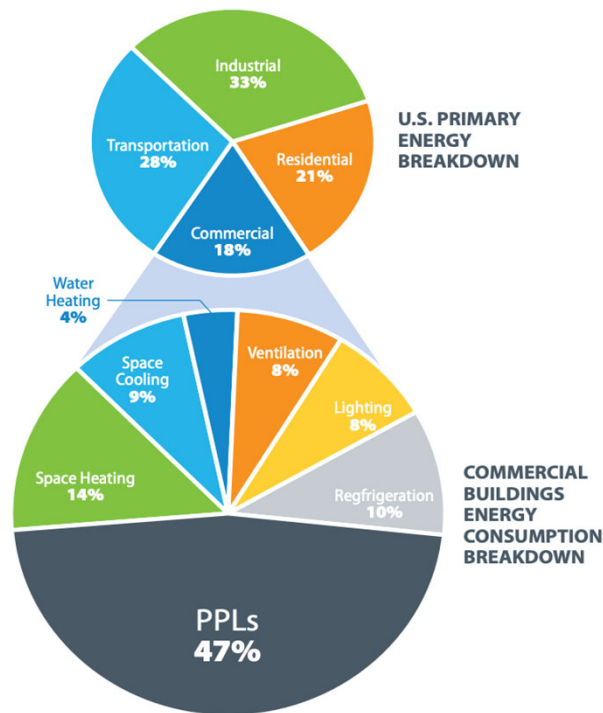
CALPLUG WORKSHOP SPRING 2023

APRIL 17, 2023

# PLETICS PROJECT OVERVIEW

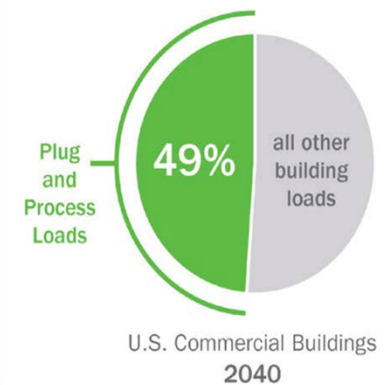
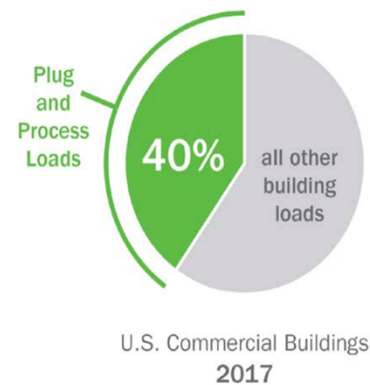
- Plug Load Energy Testing for Informing Codes and Standards
- Purpose:
  - Funded by California Energy Commission (CEC)
  - Assess opportunities for new CA codes and standards for products not currently included in state energy efficiency regulations (such as CA Titles 20 & 24)
  - Focused on three device categories: commercial imaging devices, residential networking equipment, and laboratory equipment
- Team:
  - California Energy Alliance (Prime)
  - CalPlug -- Commercial imaging devices
  - California State University Northridge (CSUN) – Commercial laboratory equipment
  - California Lighting Technology Center (CLTC), UC Davis – Residential networking devices

# WHY PLUG LOAD CODES & STANDARDS?



**Figure 1.** Plug and process loads account for 47% of commercial building energy consumption. Graph by Kristi Maisha, NREL; Data source: EIA (2020)

- Increasing energy intensity as % of building load
- Individual energy consumption adds up!

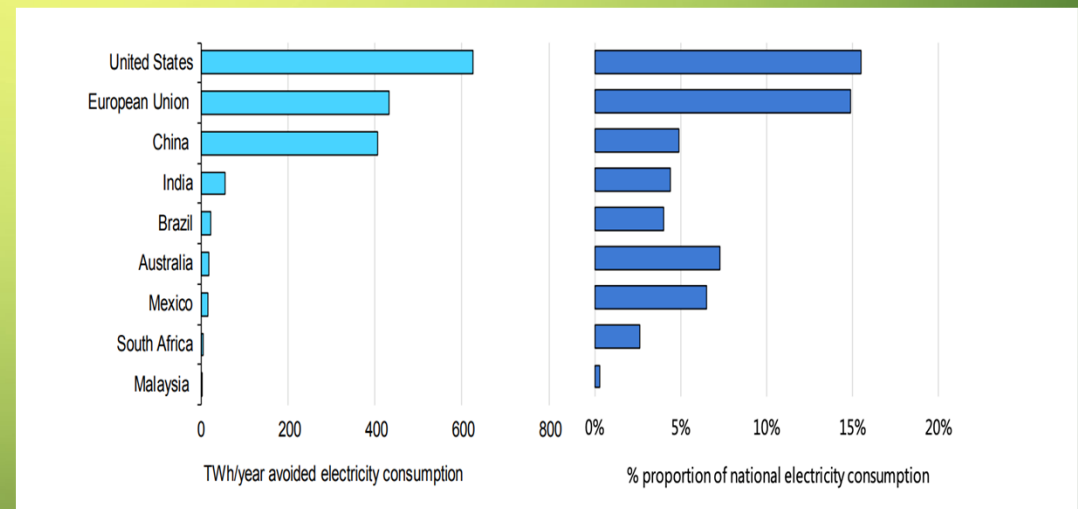


Data Source: EIA Annual Energy Outlook 2018  
Report: R Langner and K Trenbath NREL 2019

# WHY PLUG LOAD CODES & STANDARDS?

- Simply: They work!
- Energy Efficiency Standards and Labeling (EES&L) Programs
  - Minimum Energy Performance Standards (MEPS)
  - Energy Labels
  - >120 countries worldwide
  - >100 appliances and equipment across residential, commercial, and industrial sectors
  - Advanced programs save up to 15% of their country's annual total electricity consumption

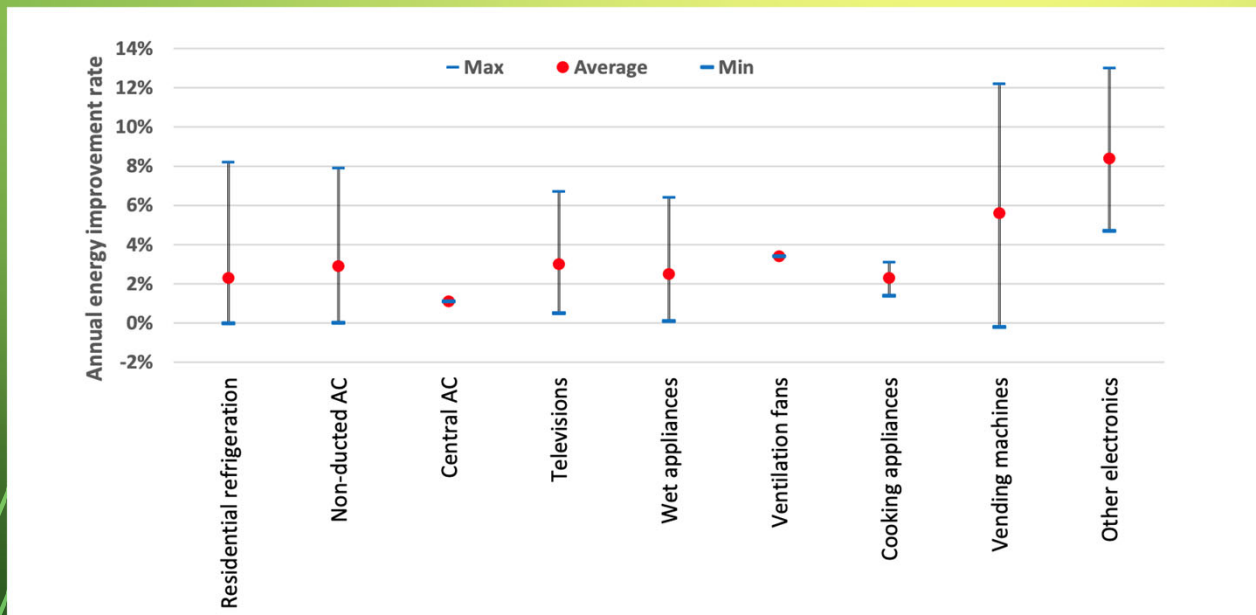
Annual Reduction in Electricity Consumption from EES&Ls



Source: International Energy Agency

# WHY PLUG LOAD CODES & STANDARDS?

Annual Energy Reduction In New-Product Energy Consumption from EES&Ls

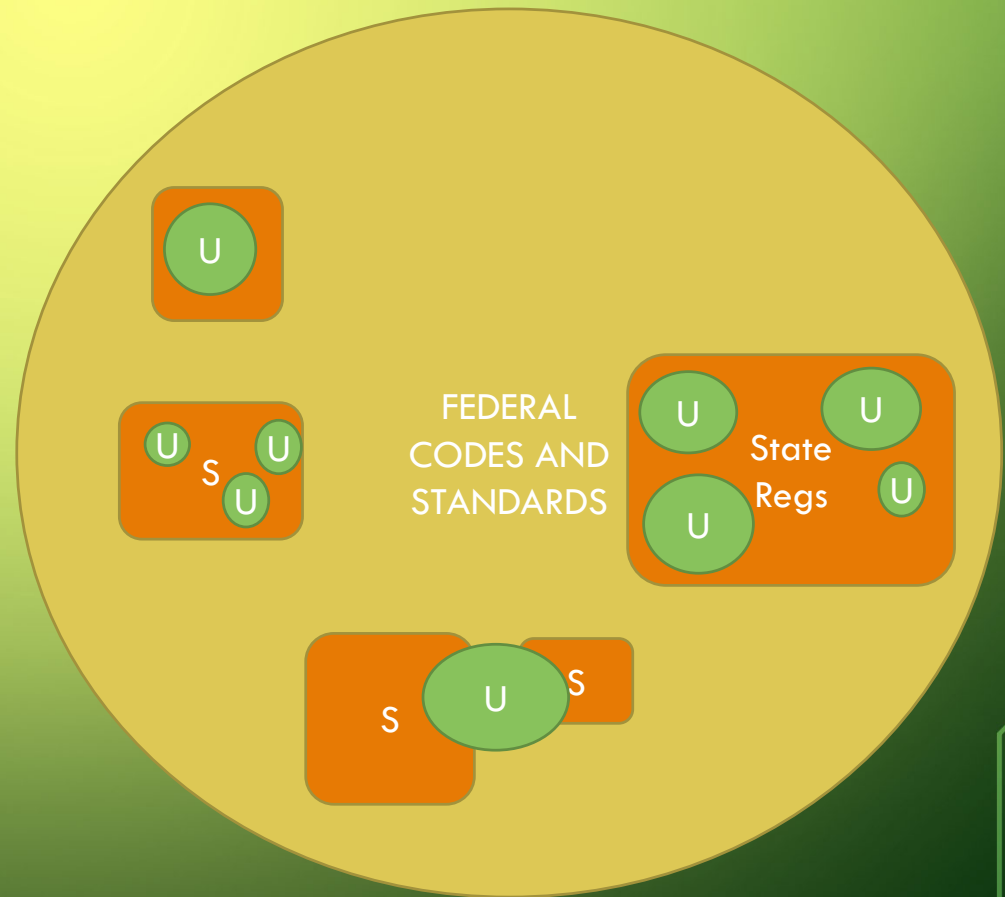


- EES&Ls help spur energy efficiency in emerging tech
- Advanced programs are attributed with reducing energy consumption by 8%/yr (and >50% over 20+ years)

Source: International Energy Agency

# US POLICY CONTEXT FOR ADVANCING PLUG LOAD ENERGY SAVINGS

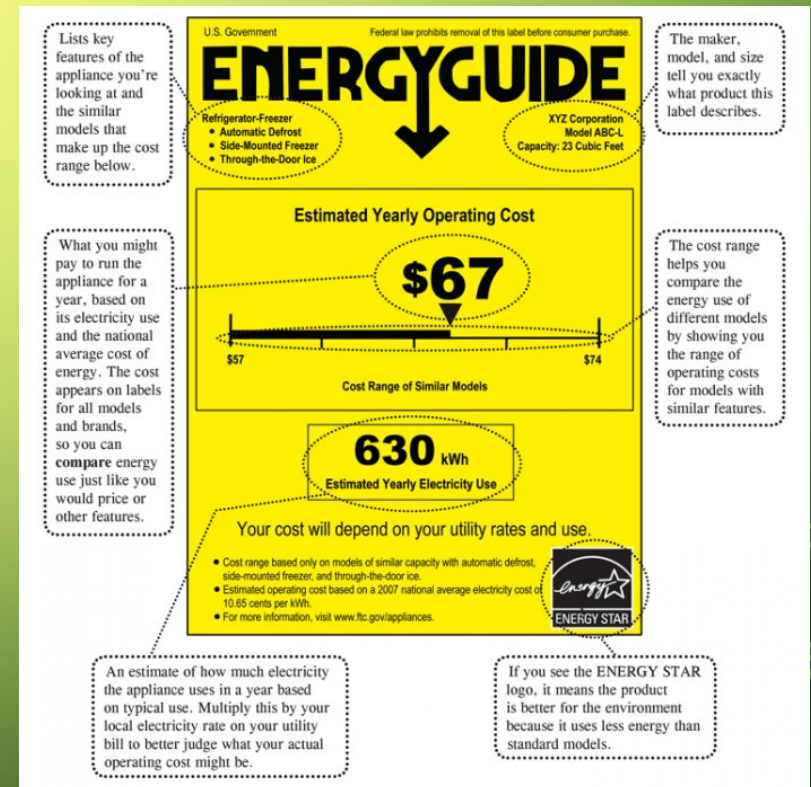
- Federal
  - Regulations
  - Voluntary agreements (Energy Star)
- States
  - Regulations (Ex. CA Title 20, SB 100)
  - Rebate programs
  - Policies mandate utility performance
- Utilities
  - Municipal or private entities implement incentive programs





# US FEDERAL CODES & STANDARDS

- DOE Federal Appliance Standards (42 USC Sections 6302(a)(5), 6316(a), and 6316(b)(1))
- FTC Appliance Labeling Rule:
  - requires appliance manufacturers to put labels on refrigerators, freezers, dishwashers, clothes washers, water heaters, furnaces, boilers, central air conditioners, room air conditioners, heat pumps, and pool heaters
- ENERGY STAR Program (Voluntary)
- International professional organization standards (IEC, ANSI)



Source: Penn State College of Earth and Mineral Sciences

# CALIFORNIA CODES & STANDARDS

## ➤ SB 100: CA Renewables Standard

- Plan for 100 percent of total retail sales of electricity in California to come from eligible renewable energy resources and zero-carbon resources by December 31, 2045.

## ➤ Title 20: Appliance Energy Efficiency Standards

- Minimum operating efficiency and cost-effective measures for energy and water conservation
- Requires more stringent standards for many federally-covered products
- introduces standards for non-federally covered products

Device	Title 20 Requirement
Television	Enter standby mode after max. 15 min. of inactivity
Disc Players and Recorders:	3 W maximum power usage in standby-passive mode
Compact Audio Products	2 W maximum power usage in standby-passive mode (Or 4 W with permanent illuminated clock display)
Desktop Computers	Transition sleep mode or off mode within 30 min. of user inactivity Transition connected displays to sleep within 15 min.



# CURRENT CODES & STANDARDS: COM. IMAGING EQUIPMENT

## Commercial Imaging Devices Codes & Standards

Name	Type	Region/Country	Year last updated	Devices covered
<b>ENERGY STAR®</b> <b>Product Specification for Imaging Equipment Eligibility Criteria Version 3.1</b>	VA and Test Methodology	U.S., used in multiple other countries	2019	Printers, MFDs, scanners, digital duplicators, mailing machines, and professional imaging products (industrial printers)
<b>EPEAT Ecolabel</b> <b>Conforms to: IEEE Standard for Environmental Assessment of Imaging Equipment Amendment 1</b>	Label	U.S., used in multiple other countries	2017	Printers, MFDs
<b>Blue Angel</b> <b>The German Ecolabel Office Equipment with Printing Function (Printers and Multifunction Devices)</b>	Label	European Union	2017	Products with printing as primary function; capable to print monochrome or color; and either inkjet (IJ) or electrophotographic (EP)/laser print deposition
<b>IEC 62301 Ed. 2.0 b:2011</b> <b>Household Electrical Appliances - Measurement of Standby Power (measures standby only)</b>	Standard	U.S., used in multiple other countries	2011	Electrical products with a rated input voltage or voltage range that lies wholly or partly in the range 100V to 250V for single phase products and 130V to 480V for other products

## Laser Printers: Energy Consumption and Market Data

Device Type - TEC Method (EP)	Speed/ Images per Minute (ipm)	UEC: TEC (kWh/yr) (	Market Size (\$ Millions)	Compound Annual Growth Rate (CAGR) 2021-2026
<b>Monochrome Non-MFD</b>	$s \leq 20$	< 20	39,208 (All lasers)	3.6% (All lasers)
	$20 < s \leq 40$	8.84 - 27.04		
	$40 < s \leq 60$	18.2 - 46.28		
	$60 < s \leq 135$	37.44 - 47.84		
<b>Monochrome MFD</b>	$s > 135$	>900		
	$s \leq 20$	<15		
	$20 < s \leq 40$	9.88- 30.68		
	$40 < s \leq 60$	20.8 - 49.92		
<b>Color Non-MFD</b>	$60 < s \leq 80$	35.88 - 76.96		
	$s > 80$	75.4 - >100		
	$s \leq 20$	17.68		
	$20 < s \leq 40$	10.92 - 38.48		
<b>Color MFD</b>	$40 < s \leq 60$	22.88 - 45.76		
	$s > 60$	> 452		
	$s \leq 20$	9.88 - 10.4		
	$20 < s \leq 40$	12.48 - 32.76		
	$40 < s \leq 60$	23.92 - 50.44		
	$60 < s \leq 80$	53.04- 447.2		
	$s > 80$	>500		

## Inkjet Printers: Energy Consumption and Market Data

Device Type	Speed (ipm)	UEC: Power in Sleep Mode (W)	Market Size Estimate 2026 (\$ millions)	CAGR 2021-2026
<b>Monochrome Non-MFD</b>	20-24 ipm	0.6- 0.9	13,854 (All inkjets)	3.3% (All inkjets)
<b>Monochrome MFD</b>	20-24 ipm	0.6 - 1.1		
<b>Color Non-MFD</b>	01-25 ipm	0.5 - 1.6		
<b>Color MFD</b>	04-10 ipm	0.2 - 4.3		

# CURRENT CODES & STANDARDS: RESIDENTIAL NETWORKING EQUIPMENT

**Residential Networking Equipment C&S**

Name	Type	Region/Country	Year last updated	Device Types covered
<b>ENERGY STAR Product Specification for SNE Version 1.0</b>	VA and Test Methodology	Open to North American, Taiwan, Europe, Australia, New Zealand, and Japan Market	2014	IAD, Routers, Modems, ONTs, Range Repeaters
<b>Voluntary Agreement for Ongoing Improvement of SNE</b>	VA	United States	2020	IAD, Router, Modems, Range Repeaters
<b>Code of Conduct on Energy Consumption of Broadband Equipment Version 7.0</b>	Standard	European Union	2019	IAD, Routers, Modems, ONTs, Range Repeaters
<b>Canadian Voluntary Agreement for SNE</b>	VA	Canada	2020	IAD, Router, Modems, Range Repeaters
<b>ANSI/CTA-2049</b>	Standard, Test Methodology	No limitations	2020	IAD, Routers, Modems, ONTs, Range Repeaters

**Residential Networking: Energy Consumption and Market Data**

Device	UEC	Installed Base	CAGR
<b>Integrated Access Devices (IAD)</b>	107 kWh/yr.	85 million	67% 2021-2025 (for 5G network equipment)
<b>Modem (DSL)</b>	54 kWh/yr.	8 million	
<b>Routers (wireless)</b>	59 kWh/yr.	53 million	
<b>Range Extenders</b>	23 kWh/yr.	2 million	
<b>Optical Network Terminal (ONT)</b>	142 kWh/yr.	6 million	

# CURRENT CODES & STANDARDS: LABORATORY EQUIPMENT

## Lab Equipment: Energy Consumption and Market Data

### Lab Equipment Codes & Standards

ENERGY STAR Product Specification for Lab Freezers and Refrigerators V. 1.0

My Green Lab ACT Label for Autoclaves (TBD)

Device	UEC	Installed Base	Market Share	CAGR
Floor Stand Autoclave	11,700 kWh/yr.	16,000 (Calif.)	99% of all autoclaves	7% 2020-2024 (Global general laboratory equipment market)
Benchtop Centrifuge	91 kWh/yr.	76,000 (Calif.) 740,000 - 1.49 million (U.S.)	60% of all centrifuges	
Benchtop Incubator	262 kWh/yr.	60,000 (Calif.) 560,000 - 1.1 million (U.S.)	25% of all incubators	
Floor Stand Incubator	3,723 kWh/yr.		75% of all incubators	
Water Bath	3,850 kWh/yr.	52,000 (Calif.) 440,000 - 890,000 (U.S.)	80% of all water baths	

# PLETICS: NEXT STEPS

## ➤ **Final Test Approaches and Methodologies (Current Stage):**

- Existing solutions – Start with test methods of current codes and voluntary programs; best in class devices/features on market
- Power management / Low power modes (LPM)— how can LPM be used more efficiently; testing of real-world conditions
- Usage issues – Best design and best user interface for efficient device operation; reduce wasteful usage patterns
- Uncover solutions – Discovery-mode approach, open to new insights revealed by testing

## ➤ **Device Procurement and Testing Phase (April 2023- July/Aug 2023)**

- **Analyze results, estimate energy savings and non-energy benefits, and make final recommendations to CEC (July 2023 -- April 2024)**

## TAKE-AWAYS

- Plug loads becoming a larger portion of commercial and residential building loads as other end uses (HVAC, luminaires) are already addressed for EE
- Energy Efficiency Standards and Labeling Programs as a Solution
  - Proven effective internationally in both saving energy/reducing carbon emissions, and spurring EE in emerging tech
  - Federal and California standards as templates
- Opportunities for new product categories
  - Address issues such as LPM
  - Encourage industry to continue making energy efficiency improvements for new tech



THANK YOU!  
QUESTIONS AND COMMENTS WELCOME

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