PLETICS WRAP-UP: OFFICE IMAGING DEVICES

CALPLUG WORKSHOP

UC IRVINE

OCTOBER 21, 2024

MARKET ASSESSMENT & ENERGY SAVINGS OPPORTUNITIES

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
Monochrome Non-MFD	s ≤ 20	< 20	39,208 (All lasers)	3.6% (All lasers)
	20 < s ≤ 40	8.84 - 27.04		
	40 < s ≤ 60	18.2 - 46.28		
	60 < s ≤ 135	37.44 - 47.84		
	s > 135	>900		
Monochrome MFD	s ≤ 20	<15		
	20 < s ≤ 40	9.88- 30.68		
	40 < s ≤ 60	20.8 - 49.92		
	60 < s ≤ 80	35.88 - 76.96		
	s > 80	75.4 - >100		
Color Non-MFD	s ≤ 20	17.68		
	20 < s ≤ 40	10.92 - 38.48		
	40 < s ≤ 60	22.88 - 45.76		
	s > 60	> 452		
Color MFD	s ≤ 20	9.88 - 10.4		
	20 < s ≤ 40	12.48 - 32.76		
	40 < s ≤ 60	23.92 - 50.44		
	60 < s ≤ 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
Monochrome Non-MFD	20-24 ipm	0.6- 0.9	13,854 (All inkjets)	3.3% (All inkjets)
Monochrome MFD	20-24 ipm	0.6 - 1.1		
Color Non-MFD	01-25 ipm	0.5 - 1.6		
Color MFD	04-10 ipm	0.2 - 4.3		

TEST METHODOLOGY

➢ **Conforms to ENERGY STAR Test Method for Determining Imaging Equipment Energy Use – November 2018**

➢**TEC Calculation for Printers, Fax Machines, Digital Duplicators with Print Capability, and MFDs with Print Capability**

$$TEC_{2018} = \left[5 \times \left(E_{JOB\_DAILY} + (2 \times E_{FINAL}) + \left[24 - \frac{N_{JOBS}}{16} - (2 \times t_{FINAL}) \right] \times \frac{E_{SLEEP}}{t_{SLEEP}} \right) + 48 \times \frac{E_{SLEEP}}{t_{SLEEP}} \right].$$

Where:
- TEC_{2018} is the typical weekly energy consumption for printers, digital duplicators with print capability, and MFDs with print capability, expressed in kilowatt-hours (kWh) and rounded to the nearest 0.01 kWh for reporting;
- E_{JOB_DAILY} is the daily job energy, as calculated per Equation 5, in kWh;
- E_{FINAL} is the final energy, as measured in the test procedure, converted to kWh;
- N_{JOBS} is the number of jobs per day, as calculated in the test procedure,
- t_{FINAL} is the final time to Sleep, as measured in the test procedure, converted to hours;
- E_{SLEEP} is the Sleep energy, as measured in the test procedure, converted to kWh; and
- t_{SLEEP} is the Sleep time, as measured in the test procedure, converted to hours.

TEST EQUIPMENT

RMS Voltage Accuracy	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
RMS Current Accuracy	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
Active Power Accuracy	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
Active Energy Accuracy	0.5% up to 14 Amp continuous; up to 1.0% over 14 Amp when equipment being monitored is at 100% duty cycle
Power Factor Accuracy:	±0.02

- Test equipment consisted of the Onset HOBO Plug Load Data Logger (UX120-018) and the compatible HOBOware software installed on a connected laptop
- HOBO logger is plugged in between the device and the building wall outlet, thereby collecting information about the current flowing through it. The device records six separate metrics: watts (W), watthours (Wh), power factor (PF), voltage (V), current (A), and apparent power (VA).
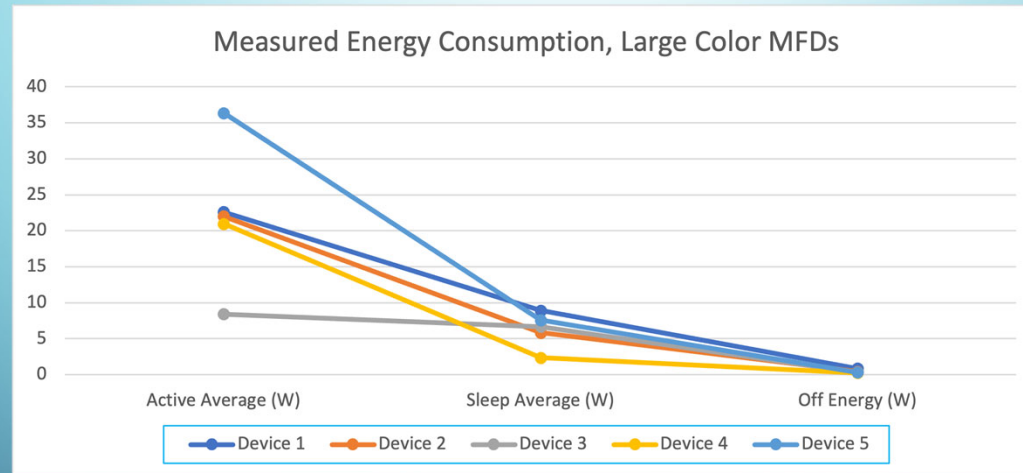
FREESTANDING COLOR MULTIFUNCTION DEVICES

Selected Devices and Manufacturer Provided Information

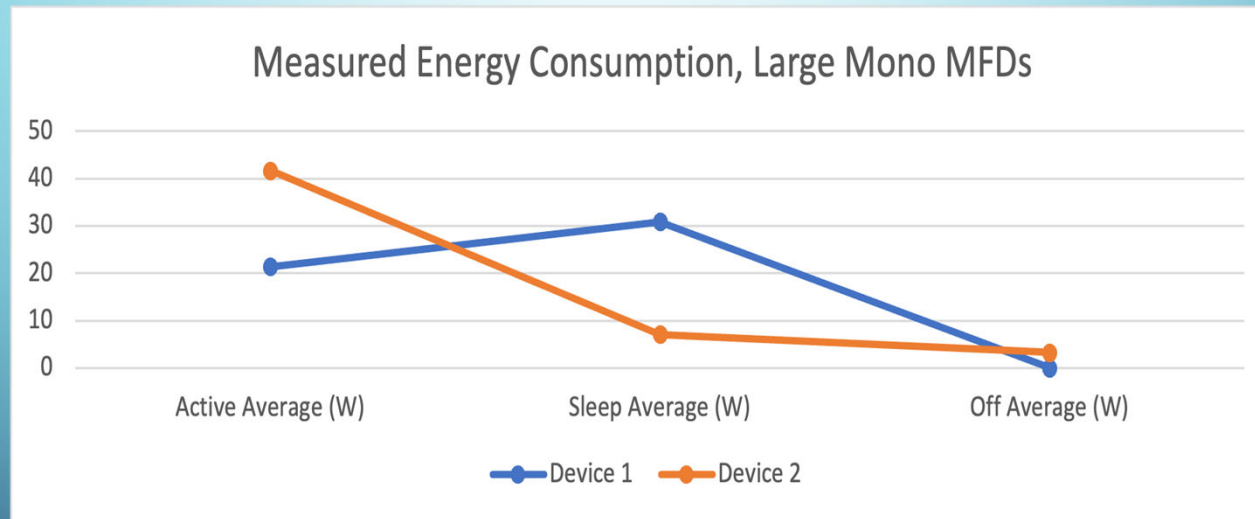| UUT	Mfr.	Model	Speed (ppm)	Advertised Power Consumption	Energy Star TEC (kWh/wk)
Large Color MFD 1	Ricoh	IM C6000	60	Active: <1,584 W; LPM: 0.59W Auto Off: N/A	0.762 (mfr.) 0.89 (Energy Star)
Large Color MFD 2	Xerox	AltaLink C8055	55	Active: 787 W avg. LPM:95 W avg. Auto Off: 1.2 W avg.	0.81 (Energy Star)
Large Color MFD 3	Ricoh	IM C300	31	Active: < 1,300 W; Sleep Mode: 0.65W	0.37 (Mfr; Energy Star)
Large Color MFD 4	Xerox	VersaLink C405	36	Active: <750 W LPM: <82 W Auto Off: <4 W	0.52 (Energy Star)
Large Color MFD 5	Xerox	C8055	55	Active: 787 W avg. LPM:95 W avg. Auto Off: 1.2 W avg.	0.81 (Energy Star)

FREESTANDING COLOR MULTIFUNCTION DEVICES

FREESTANDING MONOCHROME MULTIFUNCTION DEVICES

Selected Devices and Manufacturer Provided Information

UUT	Manufacturer	Model	Speed (ppm)	Advertised Power Consumption	Energy Star TEC (kWh/wk)
Large Mono MFD 1	Sharp	MX M407 1	40	Active: < 1500 W	0.55 (Energy Star)
Large Mono MFD 2	Ricoh	MP 4002	40	Active: 2.7W (avg) Sleep: 1W (avg)	2.87

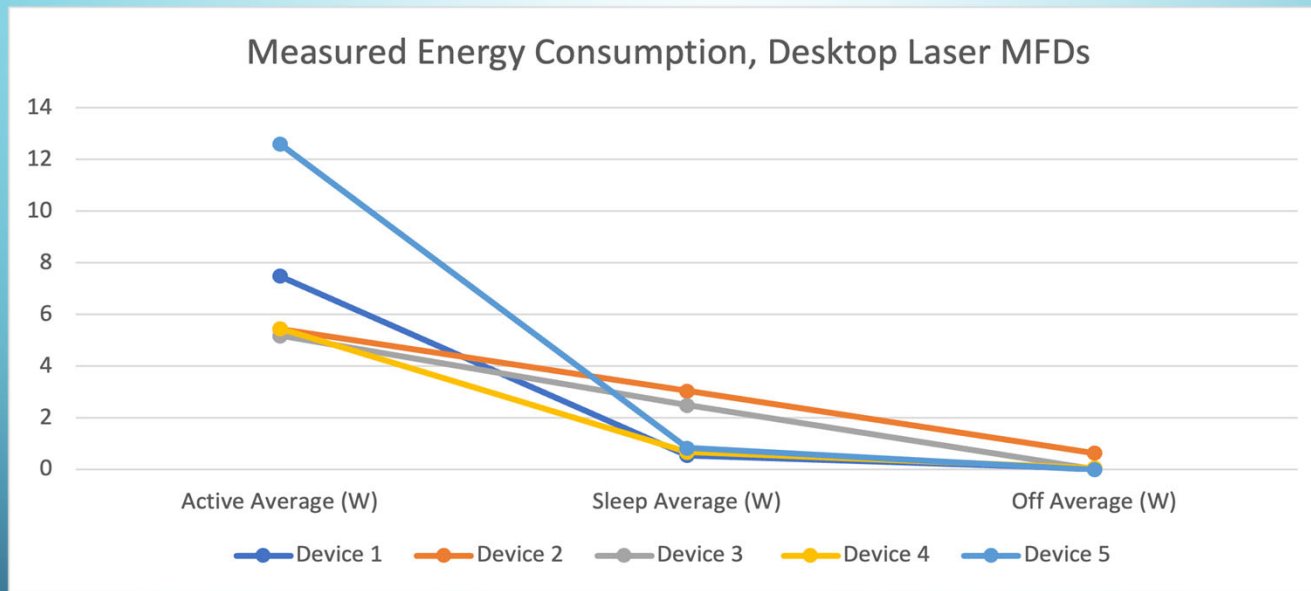# FREESTANDING MONOCHROME MULTIFUNCTION DEVICES

DESKTOP LASER MULTIFUNCTION DEVICES

Selected Devices and Manufacturer Provided Information

UUT	Mfr.	Model	Speed (ppm)	Advertised Power Consumption	ENERGY STAR TEC
Desktop Laser MFD 1	HP	LaserJet m426fdn	40	583 watts (Print/Copy), 9.1 watts (Ready), 2.7 watts (Sleep), 0.7 watts (Auto-On/Auto-Off, via USB connectivity), 0.1 watts (Shutdown or Off)	
Desktop Laser MFD 2	HP	LaserJetPro m283cdw	22	361 watts (active printing), 7.8 watts (ready), 0.8 watts(sleep), 0.05 watt (Manual-Off), 0.05 (Auto-off/Manual-on), 0.06 watt(Auto-Off/Wake on LAN) [2]	0.25
Desktop Laser MFD 3	HP	LaserJetPro M283fdw	22	361 watts (active printing), 7.8 watts (ready), 0.8 watts(sleep), 0.05 watt (Manual-Off), 0.05 (Auto-off/Manual-on), 0.06 watt(Auto-Off/Wake on LAN) [2]	0.25
Desktop Laser MFD 4	Canon	ImageClass MF751cdw	35	Maximum: Approx. 1610 W Standby: Approx. 24 W Sleep Mode: Approx. 1 W	0.34
Desktop Laser MFD 5	Brother	HL-L3290CDW	25	430 W active 75 W ready 10.1 W Sleep 1.2 W Deep Sleep 0.02 W Power Off	

DESKTOP LASER MULTIFUNCTION DEVICES

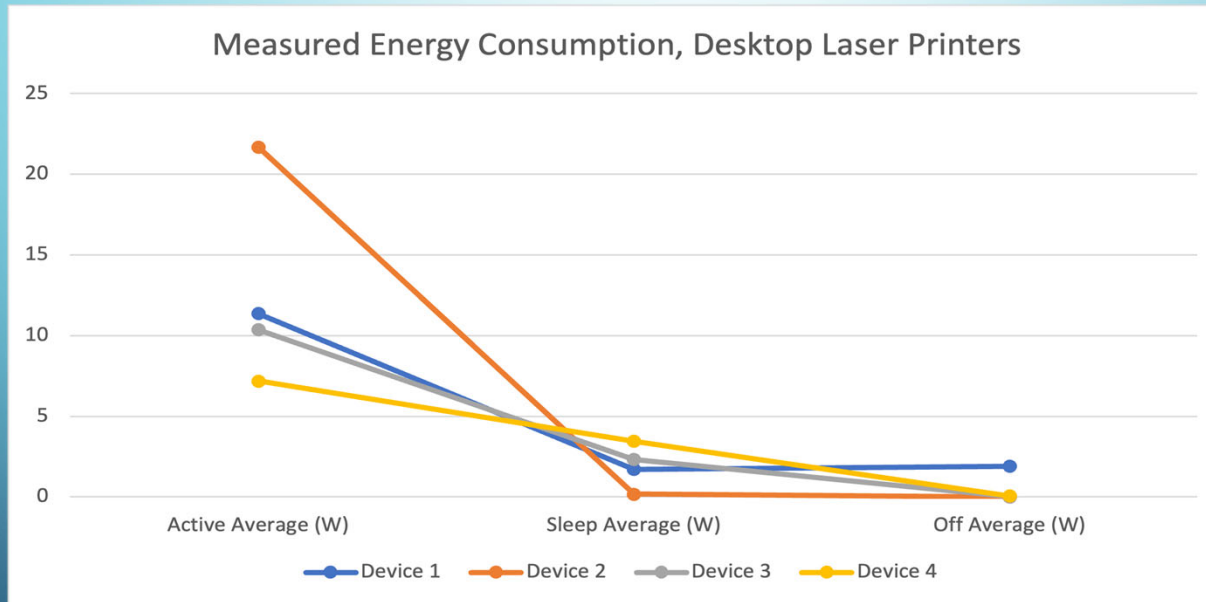Measured Energy Consumption, Desktop Laser MFDs

DESKTOP LASER PRINTERS

Selected Devices and Manufacturer Provided Information

UUT	Mfr.	Model	Speed ppm)	Advertised Power Consumption	ENERGY STAR TEC
Desktop Laser Printer 1	HP	LaserJet M607	55	780 watts (printing), 15.3 watts (ready), 3.1 watts (sleep), < 0.1 watts (Auto Off/Manual On), < 0.1 watts (Manual Off) [3]	0.6
Desktop Laser Printer 2	HP	LaserJet M551	32	780 watts (printing), 15.3 watts (ready), 3.1 watts (sleep), < 0.1 watts (Auto Off/Manual On), < 0.1 watts (Manual Off) [3]	1.36
Desktop Laser Printer 3	HP	LaserJet M452	28	Active: 570 W Ready: 17.6 W Sleep: 2.4 W Auto-off: 0.6 W Off: 0.05 W	
Desktop Laser Printer 4	HP	LaserJet M401dne	35	570 watts (Printing), 7.3 watts (Ready), 1.68 watts (Sleep), 0.1 watts (Off)	

DESKTOP LASER PRINTERS

Measured Energy Consumption, Desktop Laser Printers

INKJET COLOR MULTIFUNCTION DEVICES

Selected Devices and Manufacturer Provided Information

UUT	Mfr.	Model	Speed (ppm)	Advertised Power Consumption	Energy Star OM (W)
Inkjet MFD 1	HP	Envy 7955e	15	N/A	1.67
Inkjet MFD 2	Canon	Maxify MB2120	19	27.0W Copying (0.9W Standby)	1.17
Inkjet MFD 3	Epson	WorkforcePro WF-4830	25	Active: 22 W Power Off: 0.2 W	0.88
Inkjet MFD 4	Brother	MFC-J4535DW	35	Active: 20 W Ready: 3.5 W Sleep: 1.2 W Off: 0.2 W	0.94
Inkjet MFD 5	HP	OfficeJet 9015	22	N/A	1.08

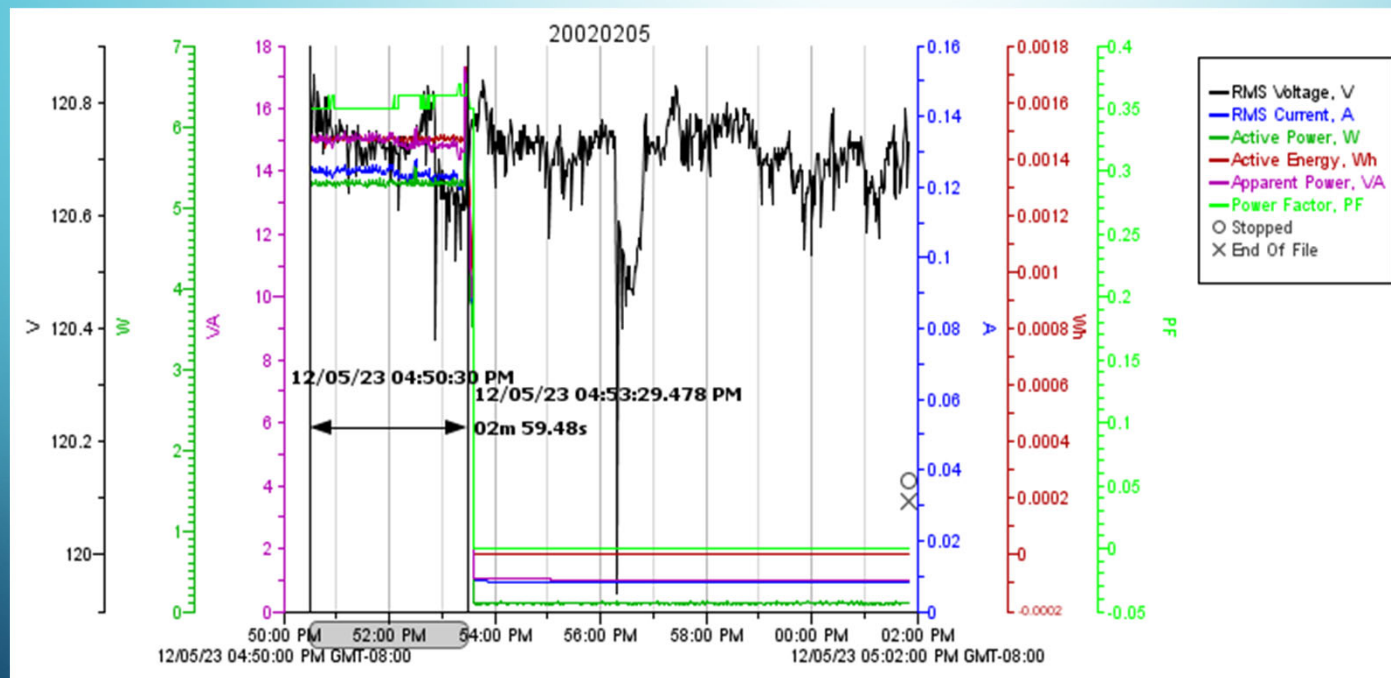# INKJET COLOR MULTIFUNCTION DEVICES

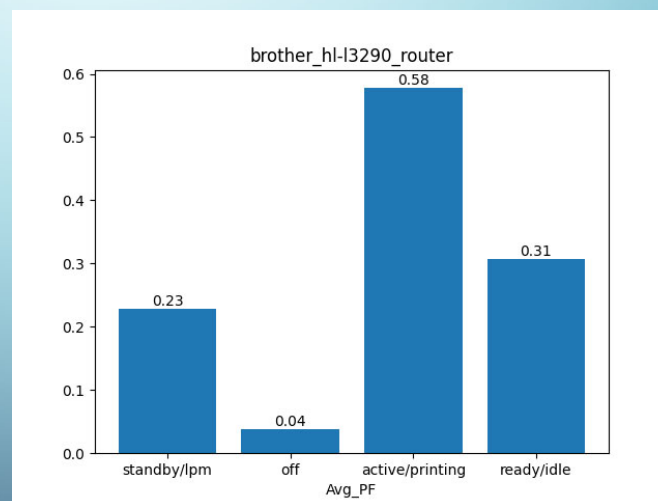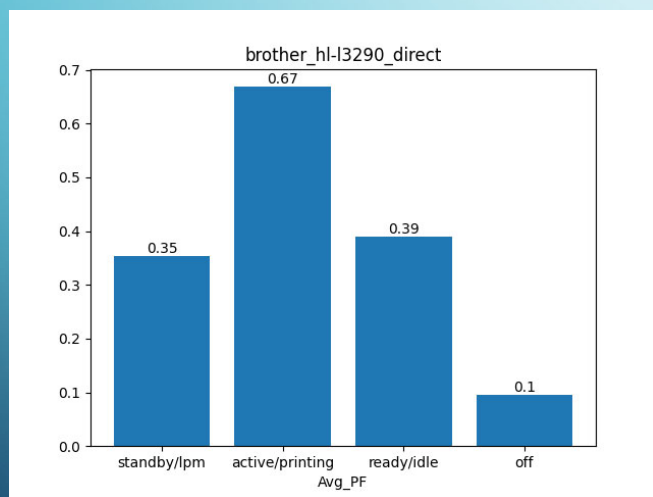Measured Energy Consumption, Inkjet Operational Mode
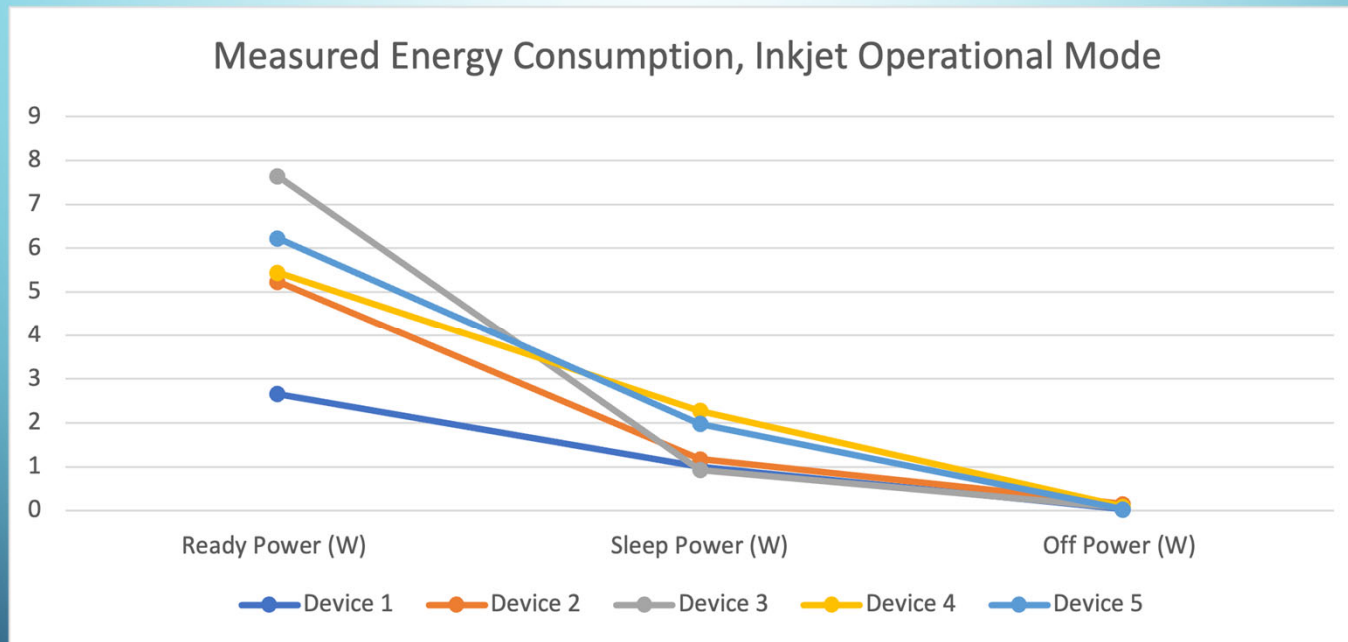
SAMPLE: TRANSITION TO SLEEP
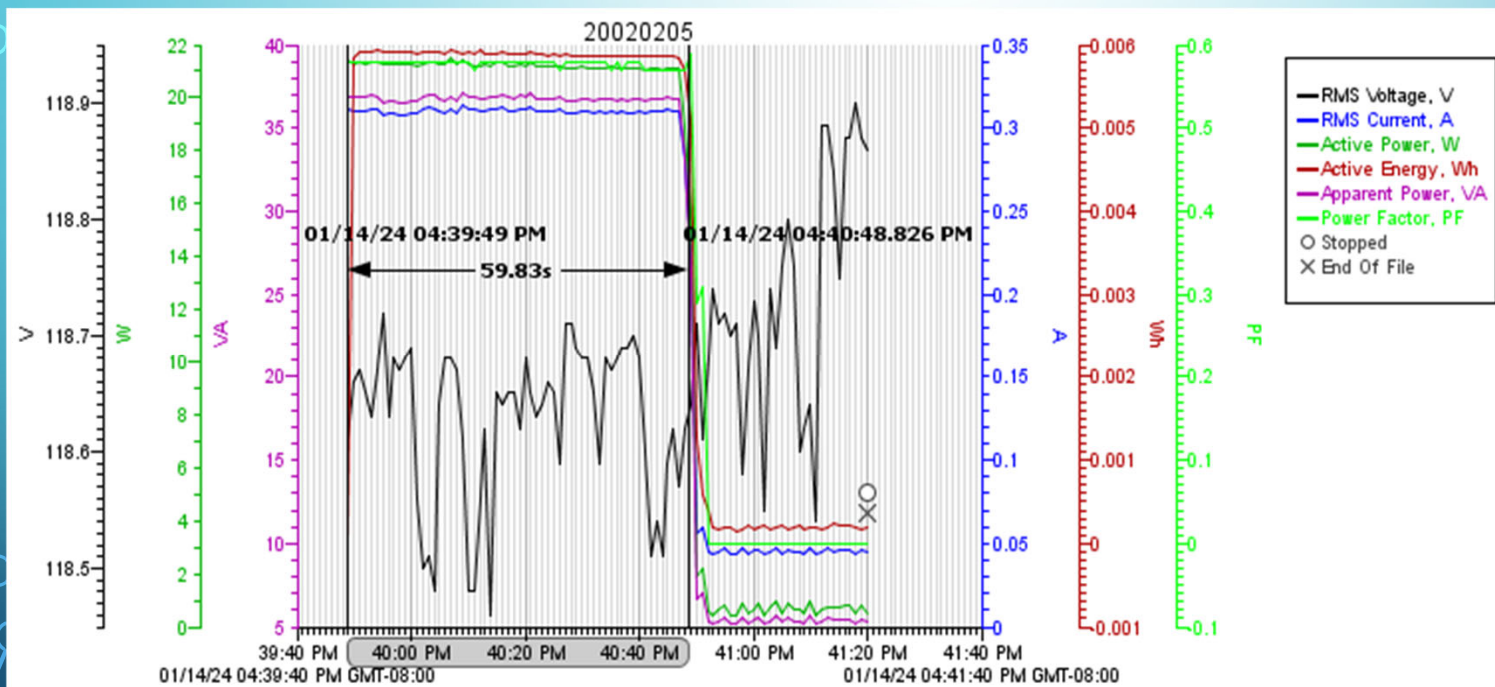
SAMPLE: AUTO OFF

POWER FACTOR

- Active Use:
  - Overall, results are in line with reported active energy usage per ENERGY STAR and manufacturer information
  - Several devices deviated severely during active use
  - Recommend: More robust testing under real-life conditions (multiple devices connected through building wi-fi network)
- Time to sleep:
  - Variation between device models and manufacturers in automatic settings
  - Recommend: Ship products with automatic standby modes enabled (e.g., 15 minutes)
- Sleep:
  - Issues with devices taking much longer than setting, or never entering sleep at all
  - Recommend: Testing to understand how connection to internet port may 'wake up' device and disrupt sleep sequence
- Non-code recommendations:
  - Recommend: Uniform labeling of energy consumption metrics
  - Recommend: Improve interface design to make sleep settings more user accessible
- Additional testing
  - Router testing to understand effects of internet traffic on device energy consumption
- Analysis for Final Report
  - Insights on power factor and harmonics
  - Energy savings estimations

OVERALL FINDINGS

Product Test List and Testing Results

Products: Desktop laser printers; desktop laser MFDs; freestanding color MFDs; freestanding monochrome MFDs; desktop color inkjets

- Freestanding Color MFDs:
    - All devices were within published ranges for active and off modes.
    - The devices exhibited higher than advertised low power mode energy usage, leading to higher TEC values compared to ENERGY STAR database.
    - Two devices also took longer than 5 hours to enter low power/sleep.

- Freestanding Monochrome MFDs:
    - One device exhibited unusually high active and off energy usage, and did not enter sleep mode in the final time-to-sleep measurement.

- Desktop Laser MFDs:
    - Two devices exhibited higher than advertised low power mode energy usage.
    - Time-to-sleep conformed to settings.

- Desktop Laser Printers:
    - All devices were within advertised ranges for all measurements.
    - Time-to-sleep conformed to settings.

- Inkjet Color MFDs:
    - One device showed higher than advertised OM.
    - All other devices were within advertised ranges.

RECOMMENDATIONS

- Develop an ENERGY STAR test method to characterize effects of internet connectivity on imaging device energy usage during active and low power modes. Test devices with internet connectivity for interference in entering progressive low power/sleep modes.

- Ship products with automatic standby modes enabled.

- Non-Code Recommendations:

  - Uniform labeling of energy consumption metrics for easier consumer comparison across products

CODES AND STANDARDS OPPORTUNITIES AND CHALLENGES

- Keep up with the market and technology, but don't limit it

- Use C&S to sweep out the least efficient products (e.g., not currently ES compliant) - relieves energy usage burden on consumers

- Implement CASE study to delve deeper into internet connectivity issues and dovetail with the low power mode test procedure currently in development

THANK YOU!

Contact: Katie Gladych

kgladych@uci.edu