

Total System Performance Through Metering

ACEEE: Market Transformation Symposium

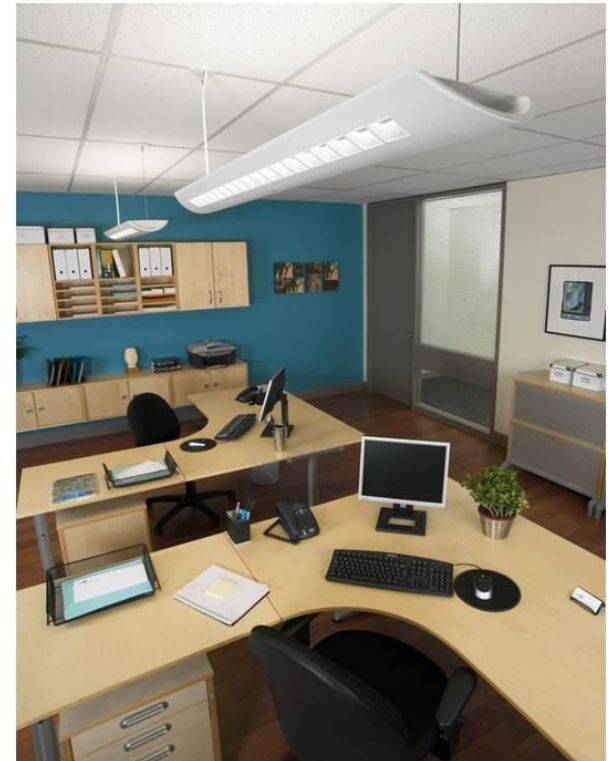
April 2, 2012

Total System Performance



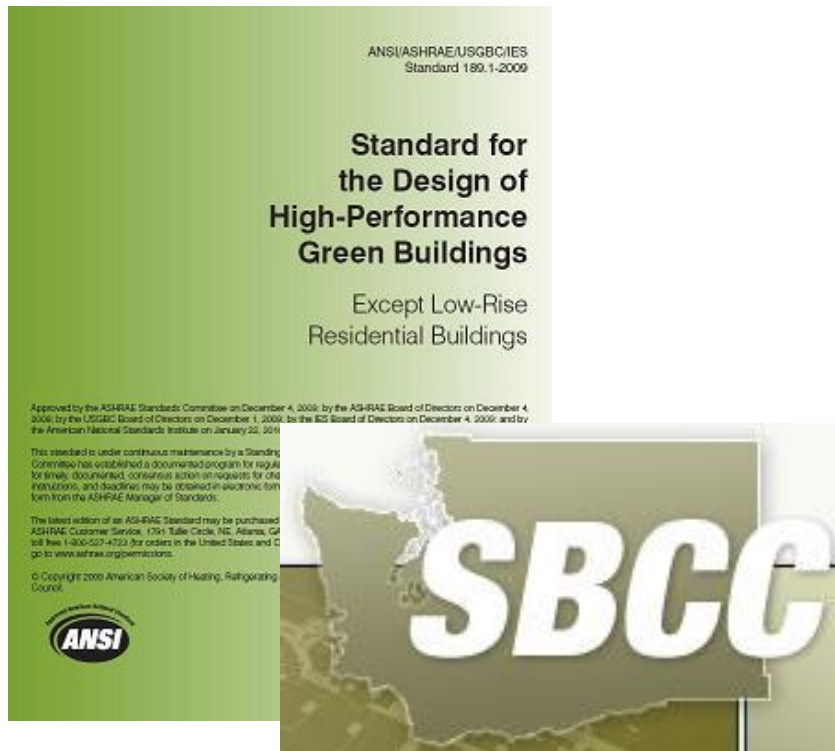
Sub-Metering Requirements

Total Lighting System Metrics



Sub-Metering Philosophies

“Magnitudinal”



“Load Type”



“Magnitudinal” Sub-Metering

TABLE 7.3.3.1A Energy Source Thresholds

Energy Source	Threshold
Electrical service	>200 kVA
On-site renewable electric power	All systems > 1 kVA (peak)
Gas and district services	>1,000,000 Btu/h (300 kW)
<i>Geothermal</i> energy	>1,000,000 Btu/h (300 kW) heating
On-site renewable thermal energy	>100,000 Btu/h (30 kW)

TABLE 7.3.3.1B System Energy Use Thresholds

Use (Total of All Loads)	Subsystem Threshold
HVAC system	Connected electric load > 100kVA
HVAC system	Connected gas or district services load > 500,000 Btu/h (150 kW)
People moving	Sum of all feeders > 50 kVA
Lighting	Connected load > 50 kVA
Process and plug process	Connected load > 50 kVA
	Connected gas or district services load > 250,000 Btu/h (75 kW)

“Magnitudinal” Sub-Metering

TABLE 12-2
COMPONENT ENERGY MASTER SUBMETERING THRESHOLDS

Component	Submetering Threshold
Chillers/heat pump systems	> 70 kW (240,000 Btu/h) cooling capacity
Packaged AC unit systems	> 70 kW (240,000 Btu/h) cooling capacity
HVAC fan systems	> 15 kW (20 hp)
Exhaust fan systems	> 15 kW (20 hp)
Make-up air fan systems	> 15 kW (20 hp)
Pump systems	> 15 kW (20 hp)
Cooling towers systems	> 15 kW (20 hp)
Boilers, furnaces and other heating equipment systems	> 300 kW (1,000,000 Btu/h) heating capacity
General lighting circuits	> 15 kVA
Miscellaneous electric loads	> 15 kVA

“Load Type” Sub-Metering

- “Load Segregation”
 - Lighting
 - HVAC
 - Plug Loads
 - Process Loads
 - Miscellaneous Building Operations
- Load Type Sub-metering of Large Buildings (>25,000 sf)

Philosophies Compared

	“Magnitudinal”	“Load Types”
FDD		
Metrics		
Construction Practices		
Equipment Cost		

Philosophies Compared

	“Magnitudinal”	“Load Types”
FDD	FDD	FDD
Metrics		
Construction Practices		
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Philosophies Compared

	“Magnitudinal”	“Load Types”
FDD	FDD	FDD
Metrics	Partial & Proxy	Direct
Construction Practices		
Equipment Cost		

Philosophies Compared

	“Magnitudinal”	“Load Types”
FDD	FDD	FDD
Metrics	Partial & Proxy	Direct
Construction Practices	No Change	Best Practices
Equipment Cost		

Philosophies Compared

	“Magnitudinal”	“Load Types”
FDD	FDD	FDD
Metrics	Partial & Proxy	Direct
Construction Practices	No Change	Best Practices
Equipment Cost	Uncertainty	Discrete Number

Office of the Future Sponsors



Technical Measures

“25% Solution” Includes:

- Advanced Lighting Design & Controls
- Plug Load Controls
- Low-Cost-No-Cost HVAC Review
- M&V interval data
- Equipment Guidelines
- Occupant Education



Technical Measures

“25% Solution” Includes:

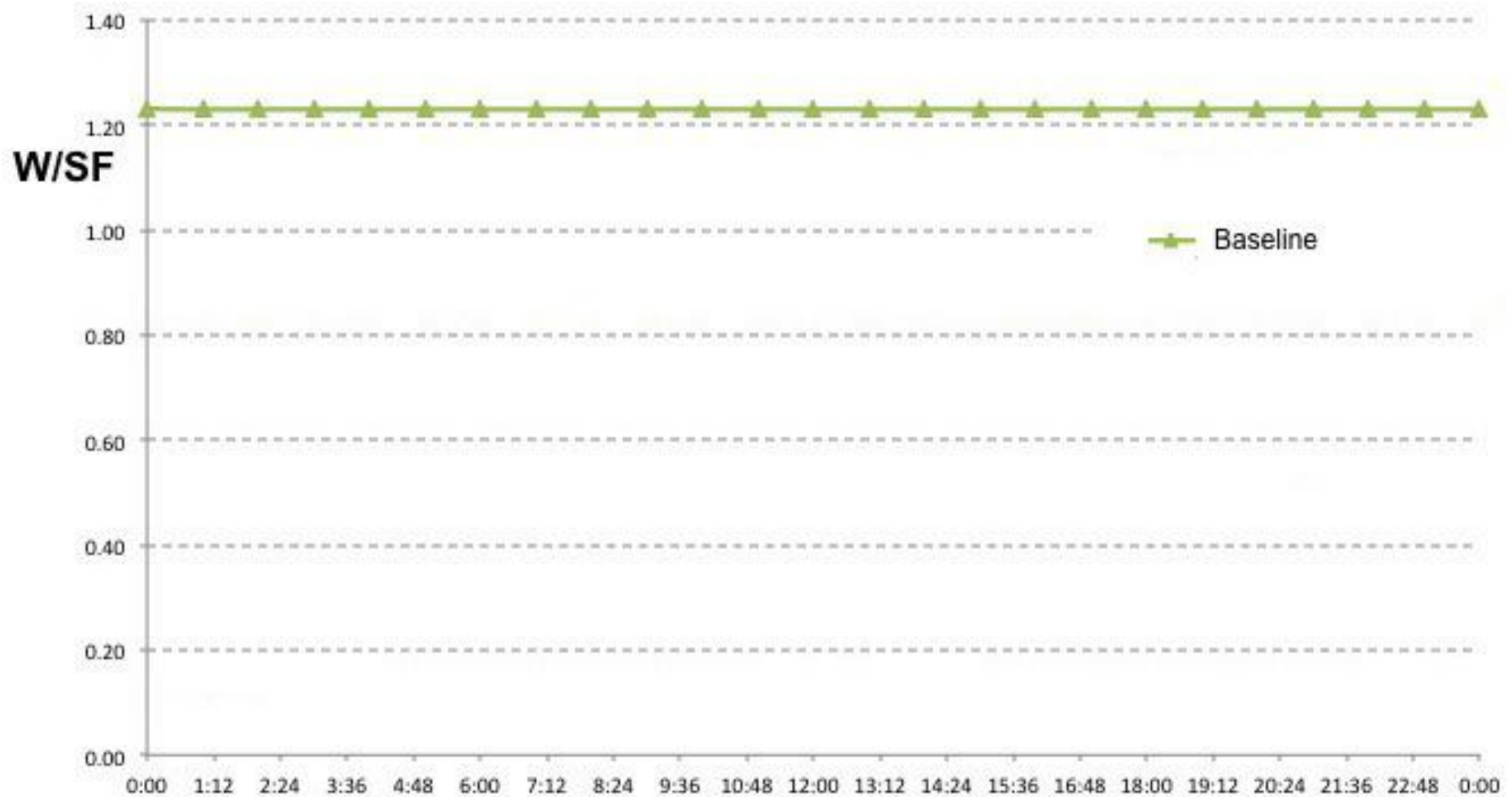
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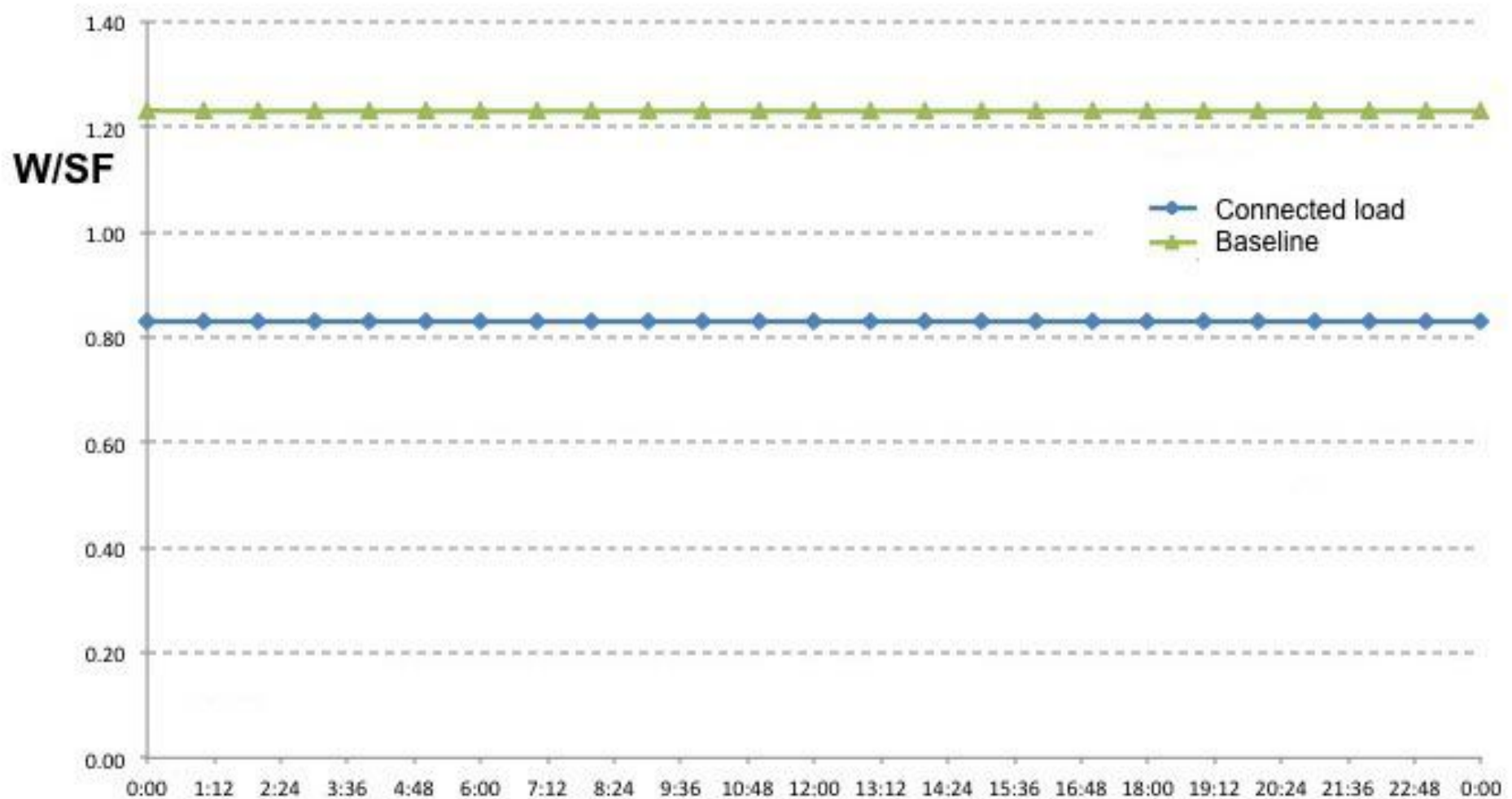
Traditional LPD Approach

BUILDING AREA TYPE^a	LPD (w/ft²)
Automotive facility	0.82
Convention center	1.08
Courthouse	1.05
Dining: bar lounge/leisure	0.99
Dining: cafeteria/fast food	0.90
Dining: family	0.89
Dormitory	0.61
Exercise center	0.88
Fire station	0.71
Gymnasium	1.0
Health care clinic	0.87
Hospital	1.10
Library	1.18
Manufacturing facility	1.11
Hotel / Motel	0.88
Motion picture theater	0.83
Multifamily	0.60
Museum	1.06
Office	0.90/0.85 ^b

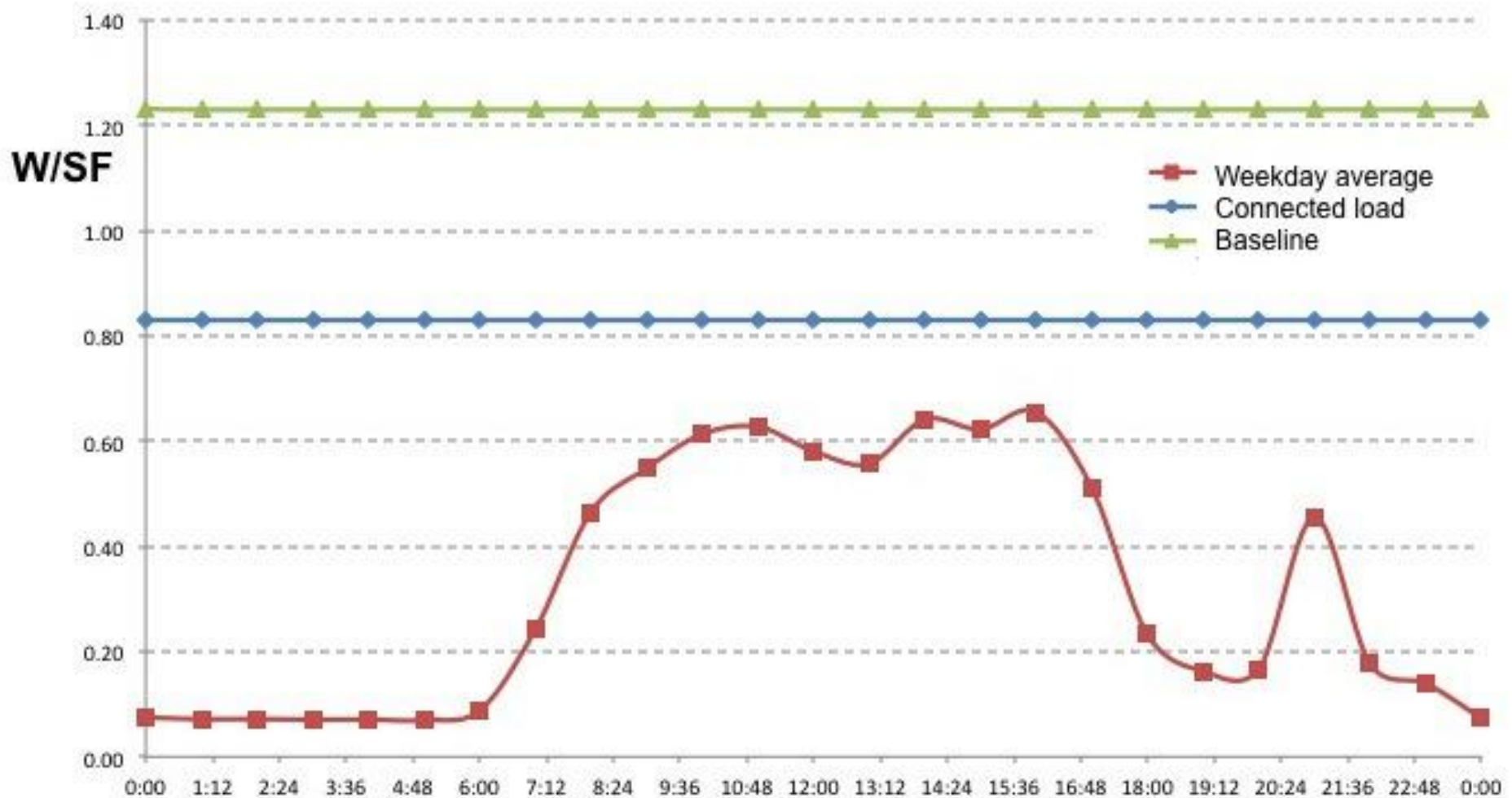
Traditional LPD Approach



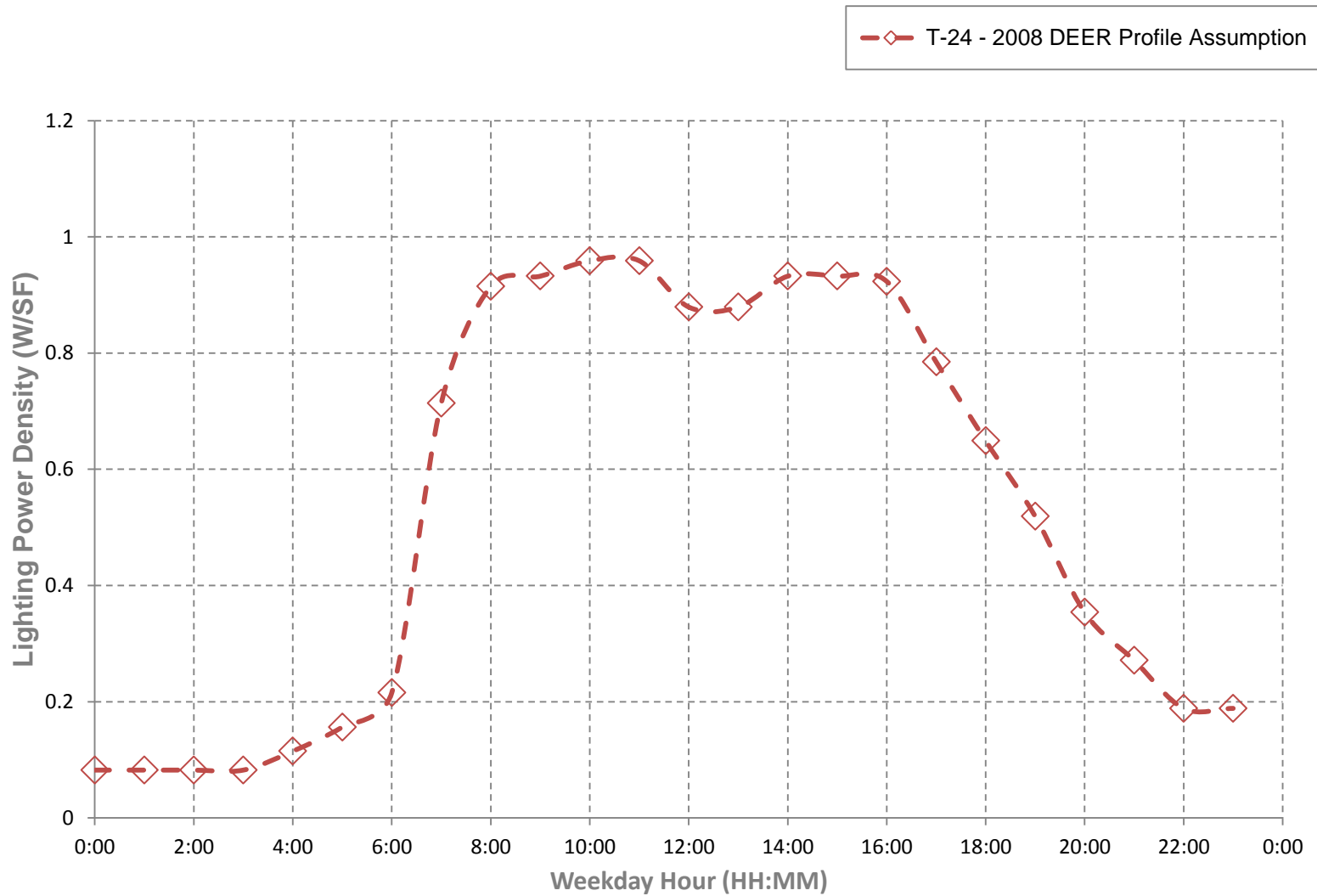
Traditional LPD Approach



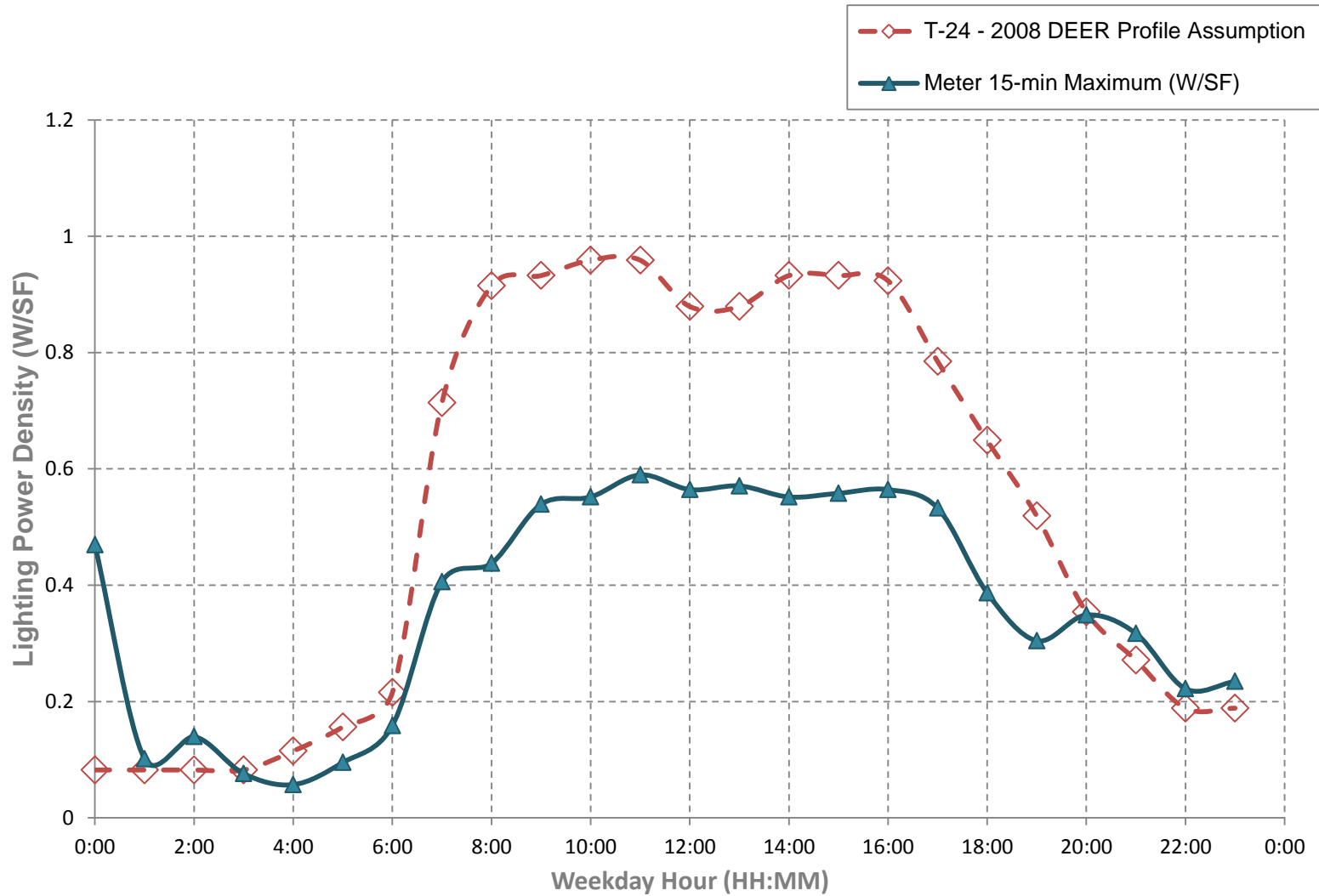
OtF Approach



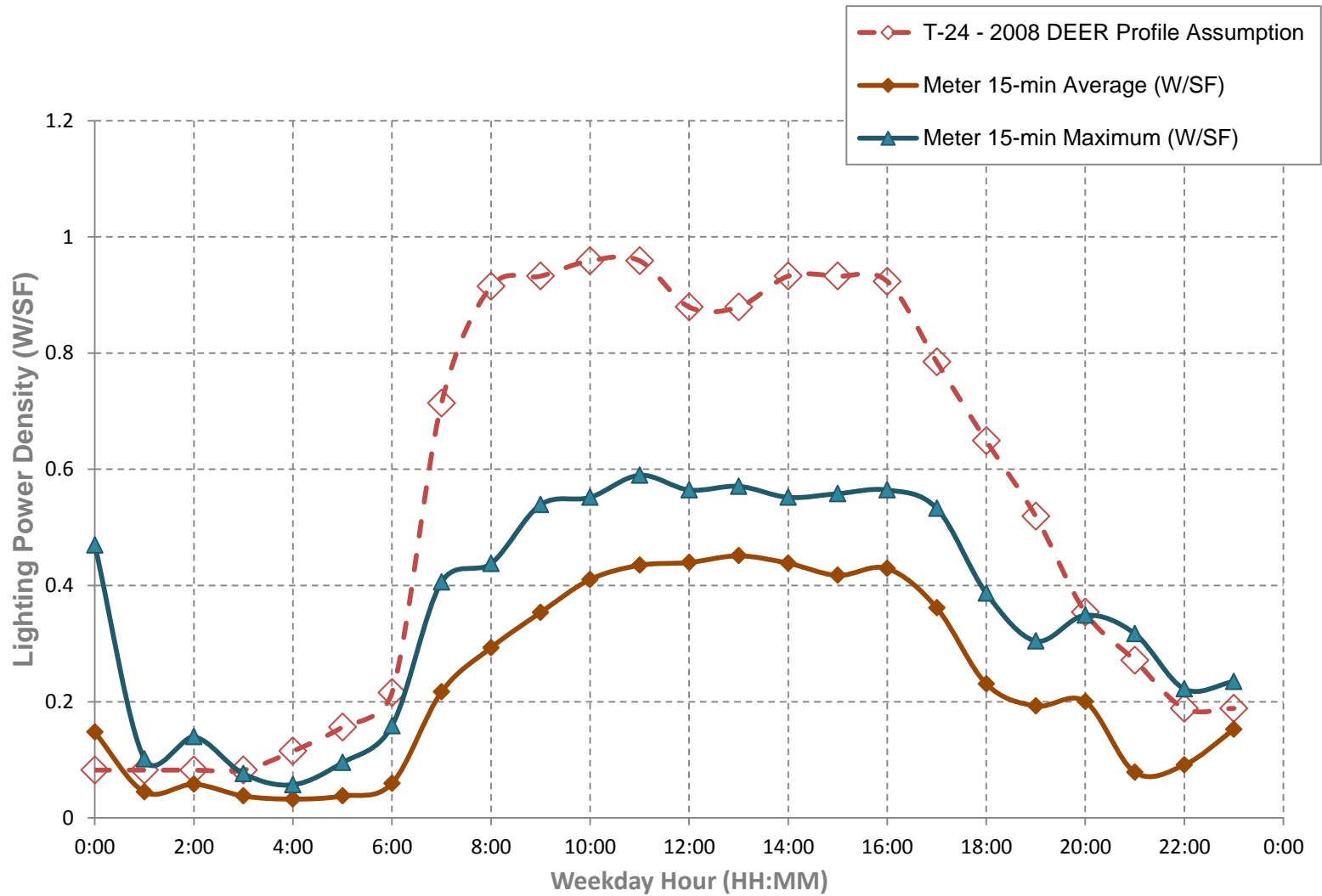
OtF Approach



OtF Approach



OtF Approach



Enlighted Hardware



elf-CU – Control Unit

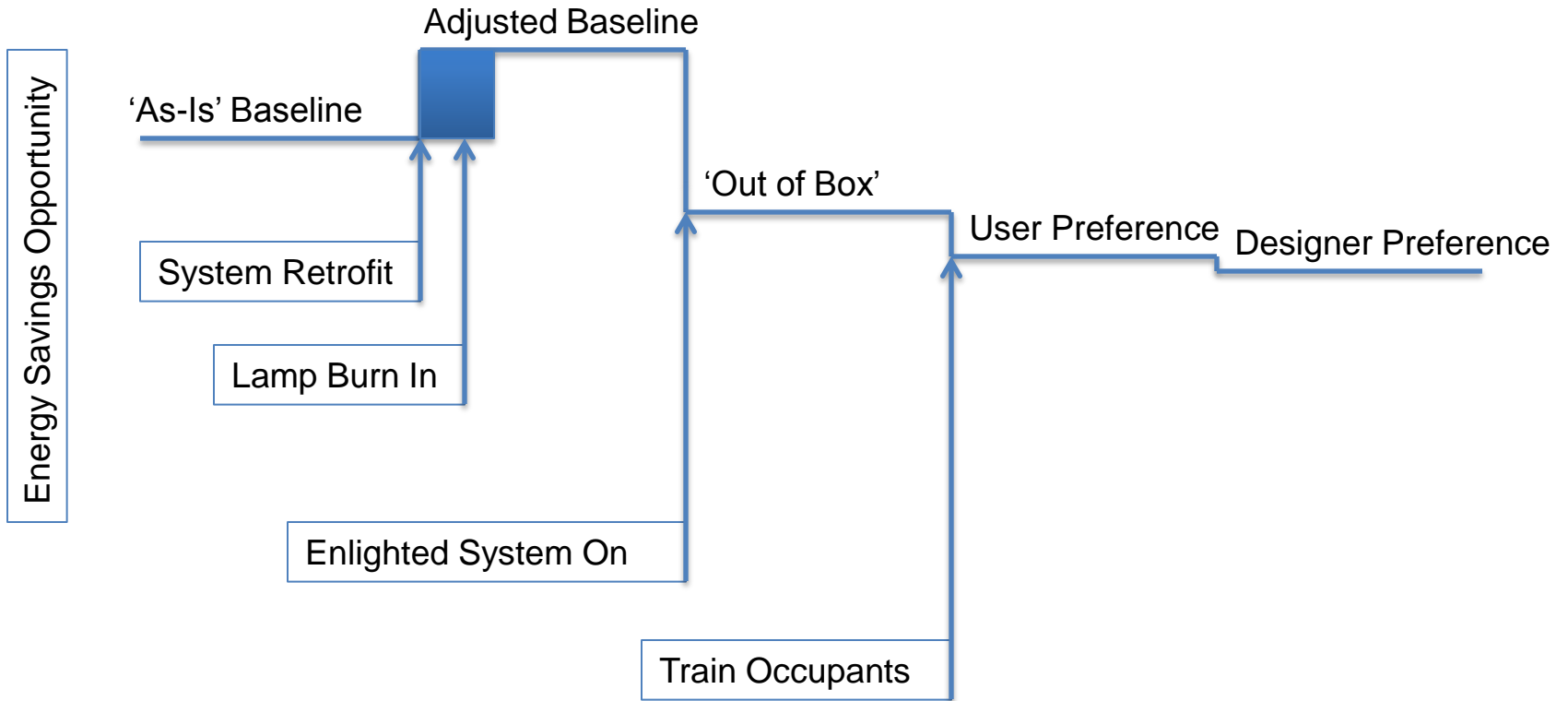


elf-SU – Sensor Unit



elf-GEM Green Energy Manager

NBI Testing Protocol



Test Location #1



Existing Condition

# Fixtures	Fixture Type	# Lamps	Lamp Type	# Ballasts	Ballast Type	System Watts	Total Watts
73	2'x4' paracube lensed troffers	3	F032 / 735 T8	2	Motorola 'First Generation' Electronic	96	7,008
2	2'x2' paracube lensed troffer	2	U tube T8	1	Motorola 'First Generation' Electronic	64	128
							7,136 W

Retrofit Condition

# Fixtures	Fixture Type	# Lamps	Lamp Type	# Ballasts	Ballast Type	System Watts	Total Watts
69	2'x4' paracube lensed troffers	2	ULTRA-START T8	1	GE 75383 – GE232MVPS-H-V03 Ultrastart 100-3% dimming EB 277 Volt circuiting	74	5,106
2	2'x2' paracube lensed troffer	2	U tube T8	1	Motorola 'First Generation' Electronic	64	128
4	2'x4' paracube lensed troffers	3	F032 / 735 T8	2	Motorola 'First Generation' Electronic	96	384

5,618 W

Average Power Demand in Metered Area*

	Installed LPD of Metered Fixtures W/SF*	Average Mon-Fri Daytime W/SF	Average M-F Night W/SF	Average Sat- Sun-Holiday W/SF	Peak W/SF
Existing	0.96	0.43	0.13	0.08	0.61
Adjusted Baseline	0.76	0.52	0.20	0.12	0.58
Out of Box	0.76	0.33	0.06	0.04	0.59
User Preference	0.76	0.31	0.06	0.04	0.42
Designer Preference	0.76				

- Daytime is defined at 6 am - 6 pm; Night is defined as 6 pm – 6 am; Sat-Sun-Holidays are a 24 hour average.

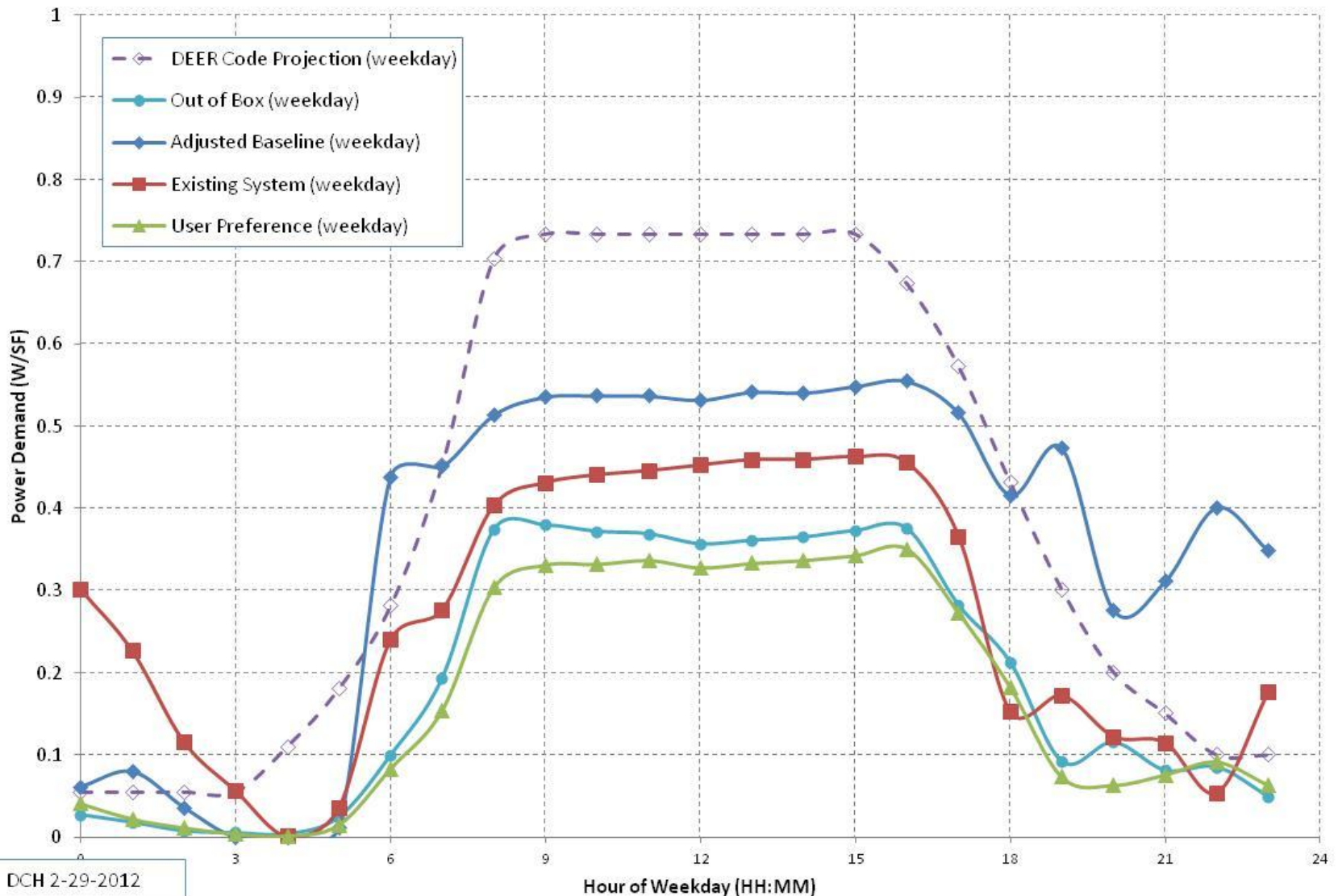
* Installed and Measured LPD does NOT include the contribution of watts from the many egress fixtures in the metered area.

Energy Consumption

Projected Measured Results Comparison

	Annual Projected kWh/YR	Annual Projected kWh/SF-YR	% Difference from Existing	% Difference from Adjusted Baseline with Full Lamp Output
Existing	14,029	1.89	-	-25%
Adjusted Baseline	18,631	2.51	33%	-
Out of Box	9,562	1.29	-32%	-49%
User Preference	8,977	1.21	-36%	-52%
Designer Preference				

Average Weekday Hourly Power Density



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Questions?

Thank You

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