Action-Oriented Benchmarking

Using CEUS Data to Identify and Prioritize Efficiency Opportunities in California Commercial Buildings

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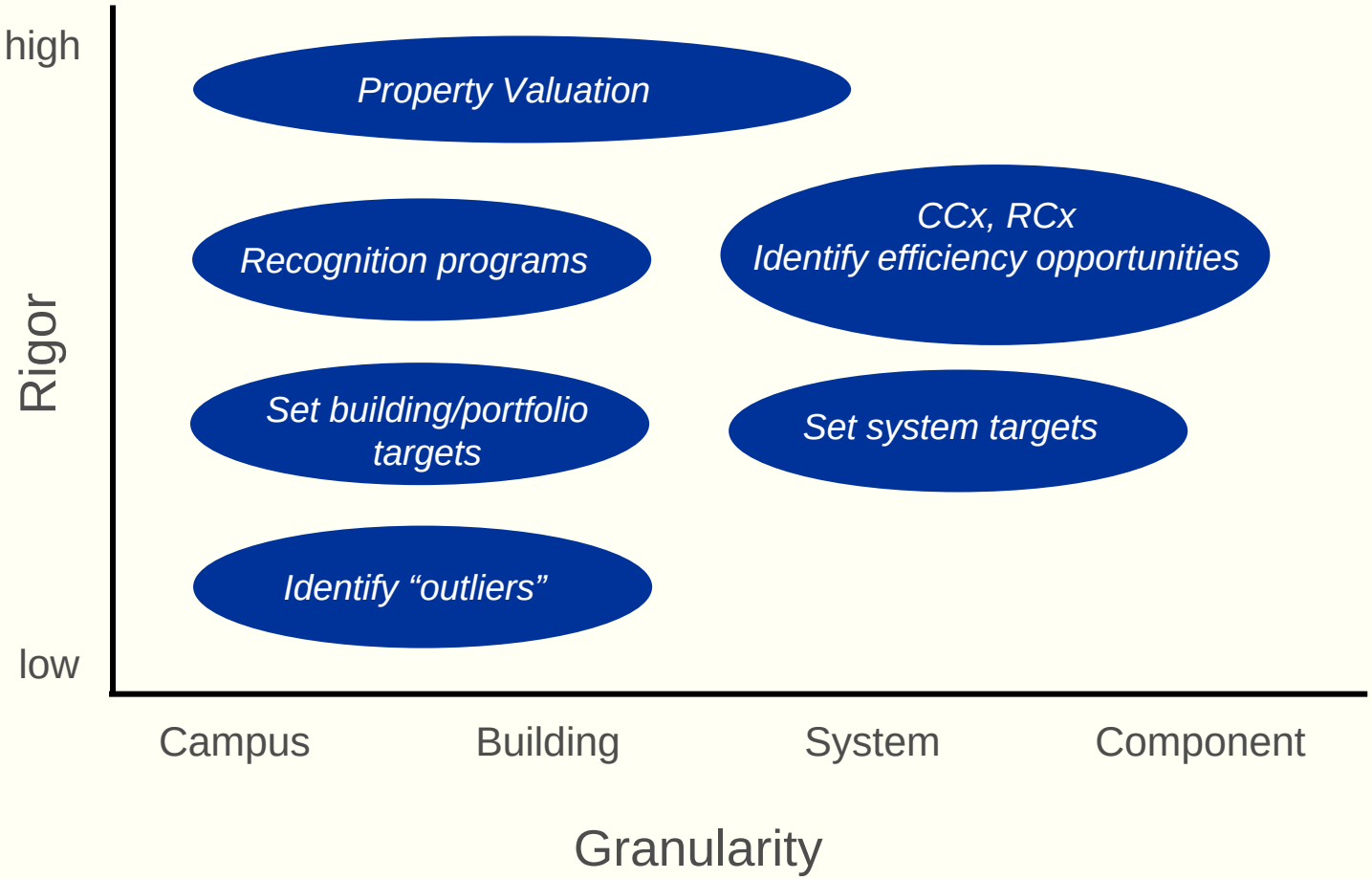
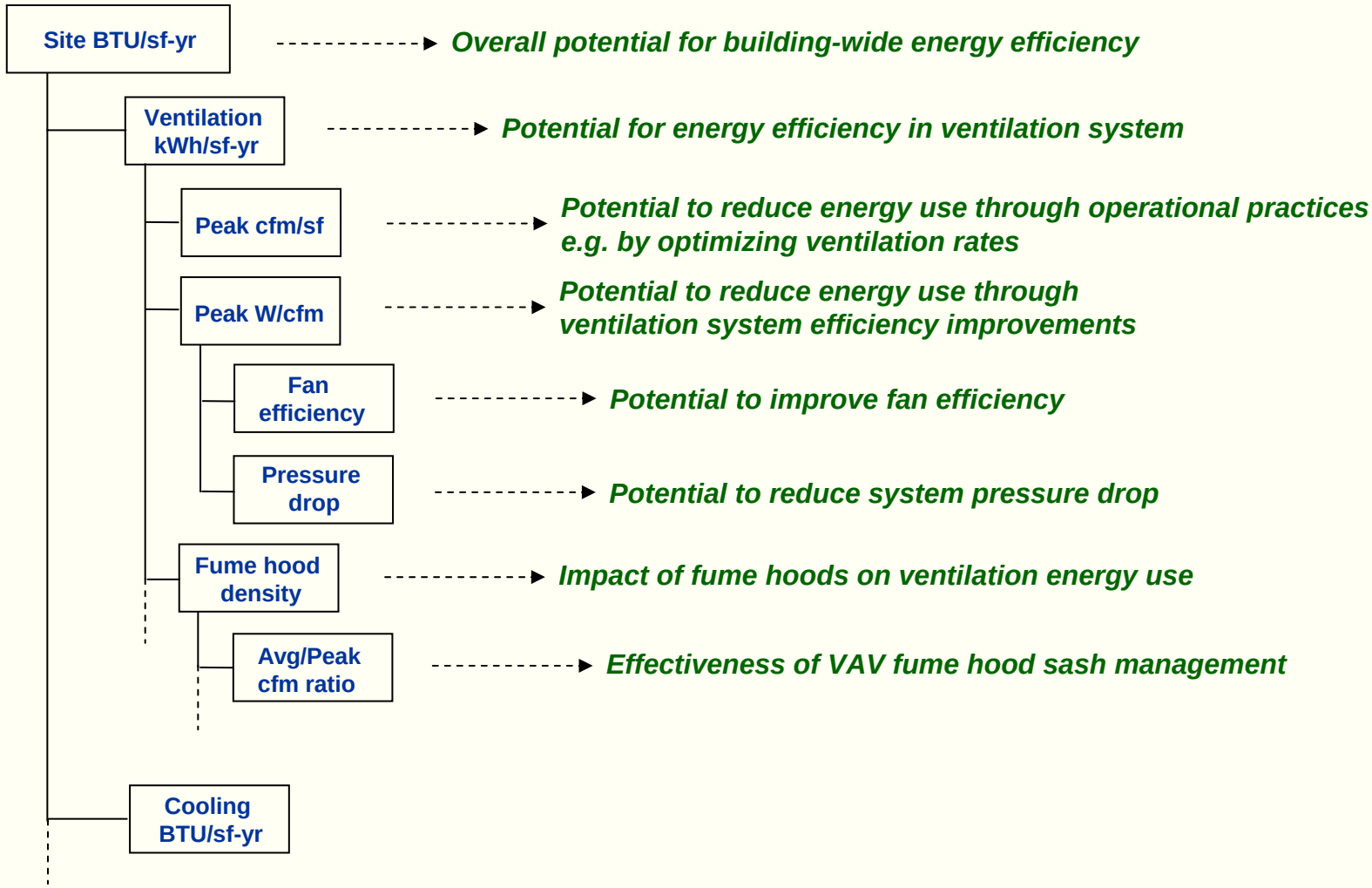
Content

- Introduction to action-oriented benchmarking
- Using the CEUS database for AOB
- AOB Vignettes – schools and offices
- Limits of AOB
- Outlook

Many Applications for Energy Benchmarking



Action Oriented Benchmarking



Action-oriented Benchmarking Complements Other Assessment Tools

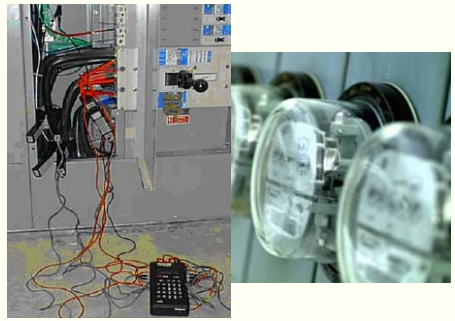
Whole Building Energy Benchmarking

Screen facilities for overall potential

0.5-2 day FTE

Minimal data requirements (utility bills, building features)

Action-oriented Energy Benchmarking



Identifies and prioritizes specific opportunities

2-10 day FTE

Requires sub-metered end-use data ; may require additional data logging

Highly applicable for RCx and CCx

Investment-Grade Energy Audit

Estimates savings and cost for specific opportunities

10-20 day FTE

Requires detailed data collection, cost estimation, financial analysis

Necessary for retrofits with capital investments

CEUS Database

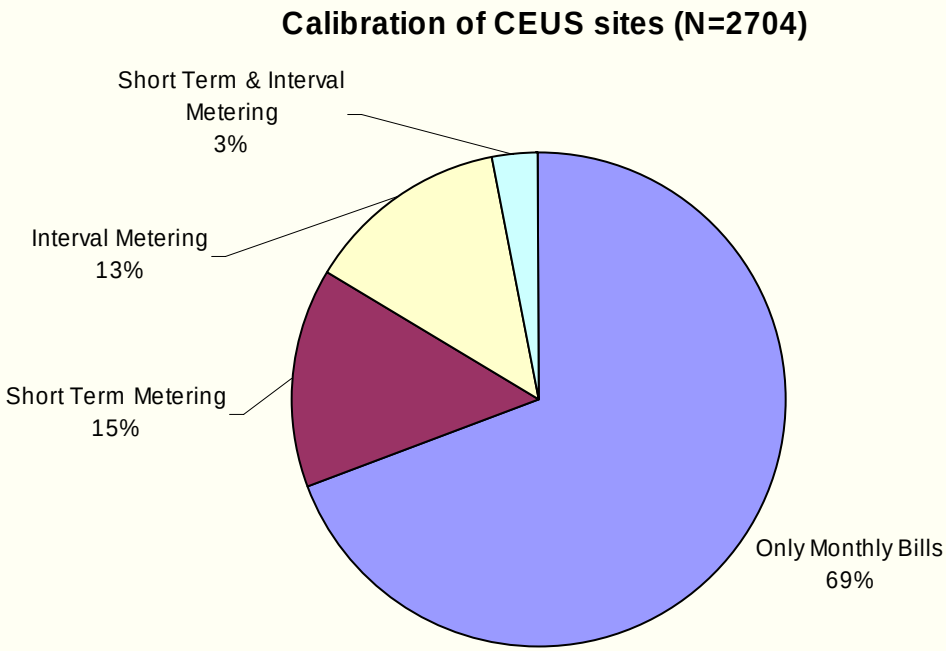
- Commercial End Use Survey
  - Territories: PG&E, SCE, SDG&E, SMUD
- Survey of 2800 premises
  - Stratified random sampling based on utility region, climate zone, building type, size (consumption)
  - On-site survey of building characteristics, features
  - Monthly utility bill data
  - Short term data logging and/or interval metering at some sites

HVAC – Single Zone Systems tblSNGLZONE

Component ID	ShellCmpID	___	___
Single-Zone Item Ltr	Item	Ltr___	Ltr ___
HVAC Schedule # from Form 10	HVACSchdNum	# __	# __
Activity Areas/Thermal Zones Served:			
Enter Area ID #(s) or A for all areas	AreaID1-8		
Floor type served *(Circle all that apply)*	FlrTyp_B_G_M_T	B G M T	B G M T
If perimeter/core, enter zones served *(Circle all that apply)*	ZoneServed_P_C	P C	P C
Distribution System Type:	DistType	SZ PSZ SSZ PTU UV 2PFC 4PFC BR ASHP GSHP WLHP	SZ PSZ SSZ PTU UV 2PFC 4PFC BR ASHP GSHP WLHP
Number of units of this type	DistUnit		
Average Age (years) -7	AvgAge		
Temperature control type:	TempControl	M A T E P	M A T E P
Optimal start/stop? (Y / N)	OptStart	Y N	Y N
Indoor/Supply fan (hp/unit)	SpHPUnit	[Missing FanonBefore FanonAfter (See Form 10c)]	
-- Motor Eff.: (Nom. %) OR (S=Std. H=HiEff P=Premium)	SpMtrEffStr		
-- Quantity of Indoor Fans	SpFanQty		
-- Supply air rate (CFM/fan) -7	SuppCFM		
Return air path: DI=Direct DU=Ducted P=Plenum -7	RtAirPath	DI DU P	DI DU P
% Outside air (minimum)	PctOA		
Economizer Type: Other__ EconoTypeOther _____	EconoType	N (T E) O	N T E O
Return fan motor (hp/unit)	RtHPUnit		
-- Motor Eff.: (Nom. %) OR (S=Std. H=HiEff P=Premium)	RtMtrEffStr		
-- Quantity of Return Fans	RtFanQty		
-- Return air rate (CFM) -7	RtCFM		
Cooling Equipment Type:	CoolType	N D C E P	N D C E P
-- *If cooling type* **D** *and not air-cooled: water (W) or evap (E) cooled?*	EvapType	W E	W E
-- *If cooling type* = **C**, *enter chilled water loop # and skip to heating equip.*	ChWLNum	CWL # ___	CWL # ___
Compressor rating: volts / amps (RLA) / phase (*circle one*)	CompVolt	CompAmps	CompPhase
Number of compressors per unit	NumComp	[Purchased Cool & Heat]	
Capacity output (nominal tons per unit)	CoolTons		
Equipment manufacturer/brand:	Make		
-- Model number for unitary or split-system outdoor unit -7	Model		
-- Model number for split-system coil -7	Model_Coil		
Efficiency: **EER** -7	CoolEER		

CEUS Calibrated Simulations

- Energy intensities derived from calibrated simulations
  - Simulation models generated from survey data
  - Calibrated with utility data, data logging, interval metering



CEUS End Uses

- HVAC
  - Space Heating
  - Space Cooling
  - Ventilation
- Lighting
  - Interior Lighting
  - Exterior Lighting
- Other
  - Water Heating
  - Office Equipment
  - Cooking
  - Miscellaneous Equipment
  - Refrigeration
  - Air Compressors
  - Motors (non-HVAC)
  - Process Equipment

Using CEUS to Infer Actions

End-Use Benchmarking

- **End-Use Intensity**
- **End-Use Breakout**

→ ***Identify and Prioritize Systems***

Building Features

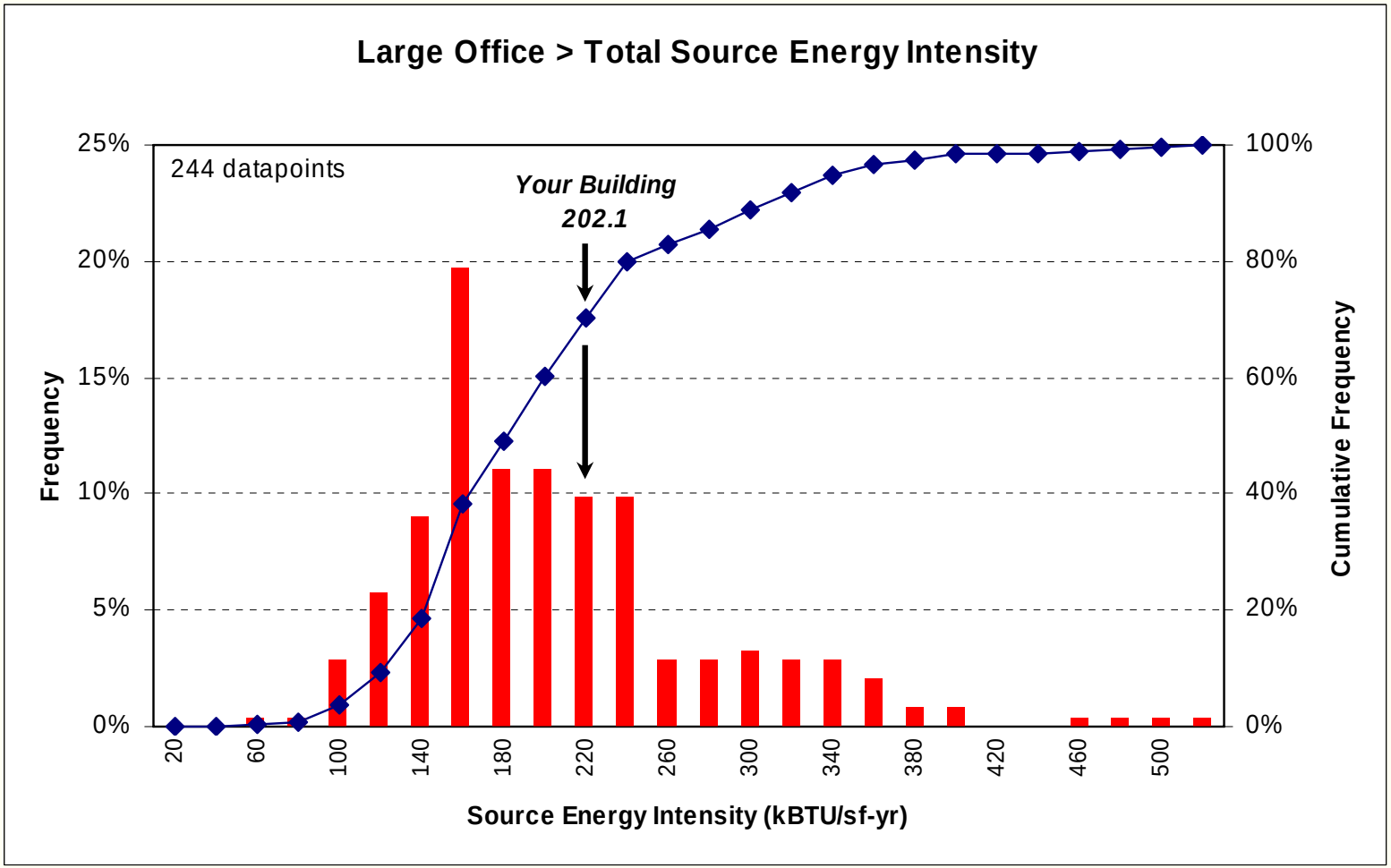
- **Presence/absence**
- **Component efficiency**

→ ***Identify Potential Actions***

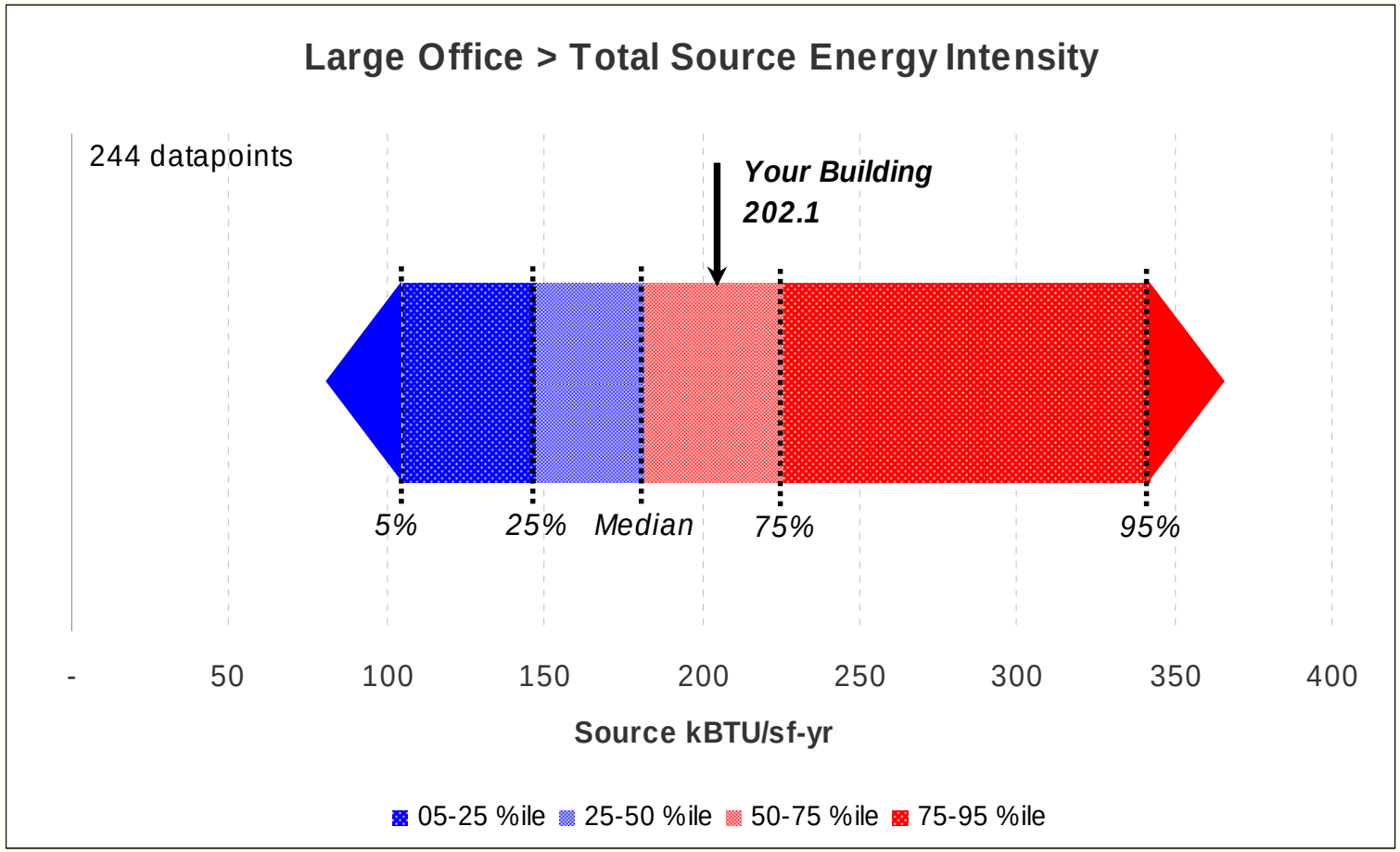
Correlate Energy Intensities & Building Features

→ ***Estimate Potential Savings***

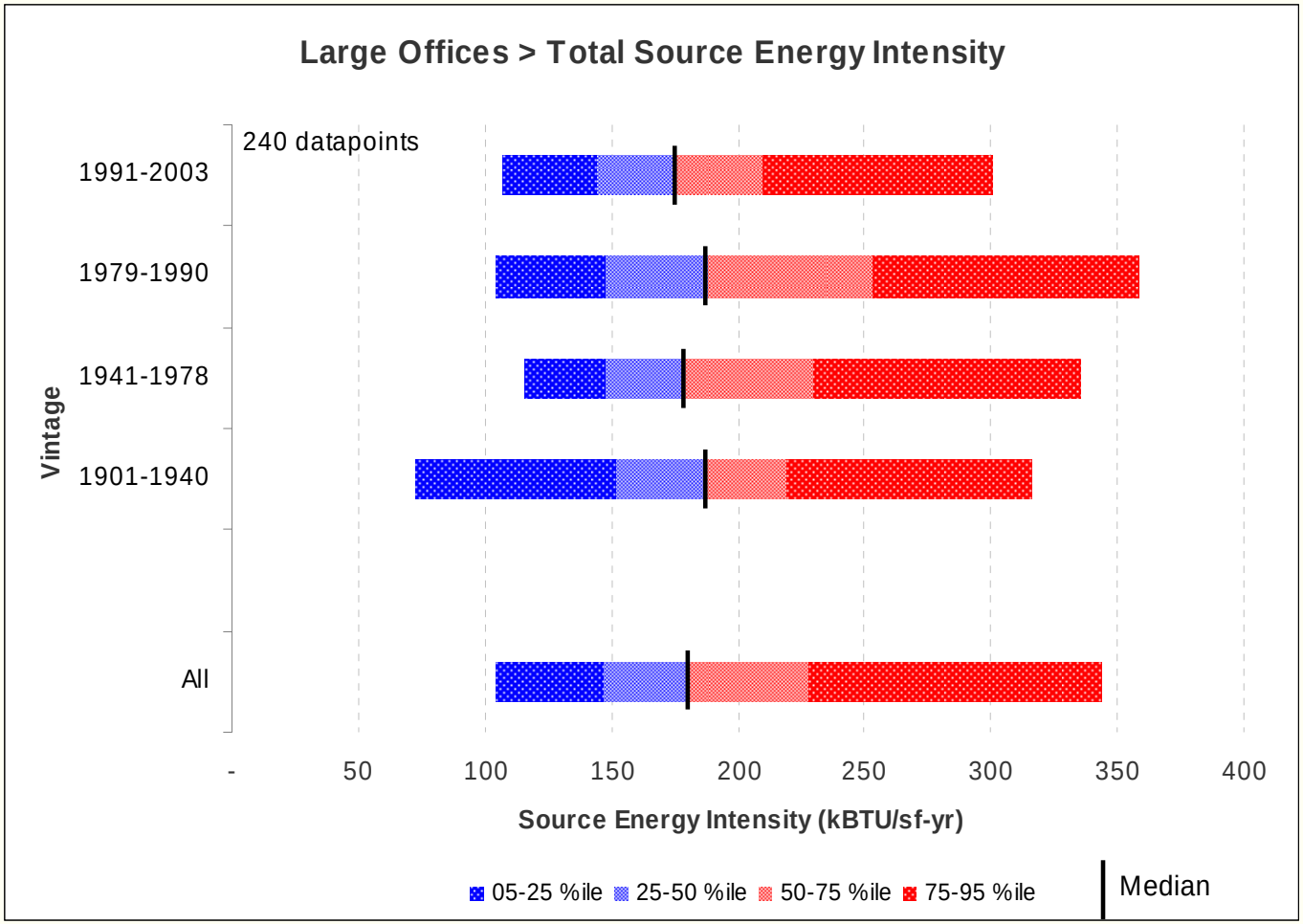
Whole Building Energy Intensity
→ Overall Efficiency Potential



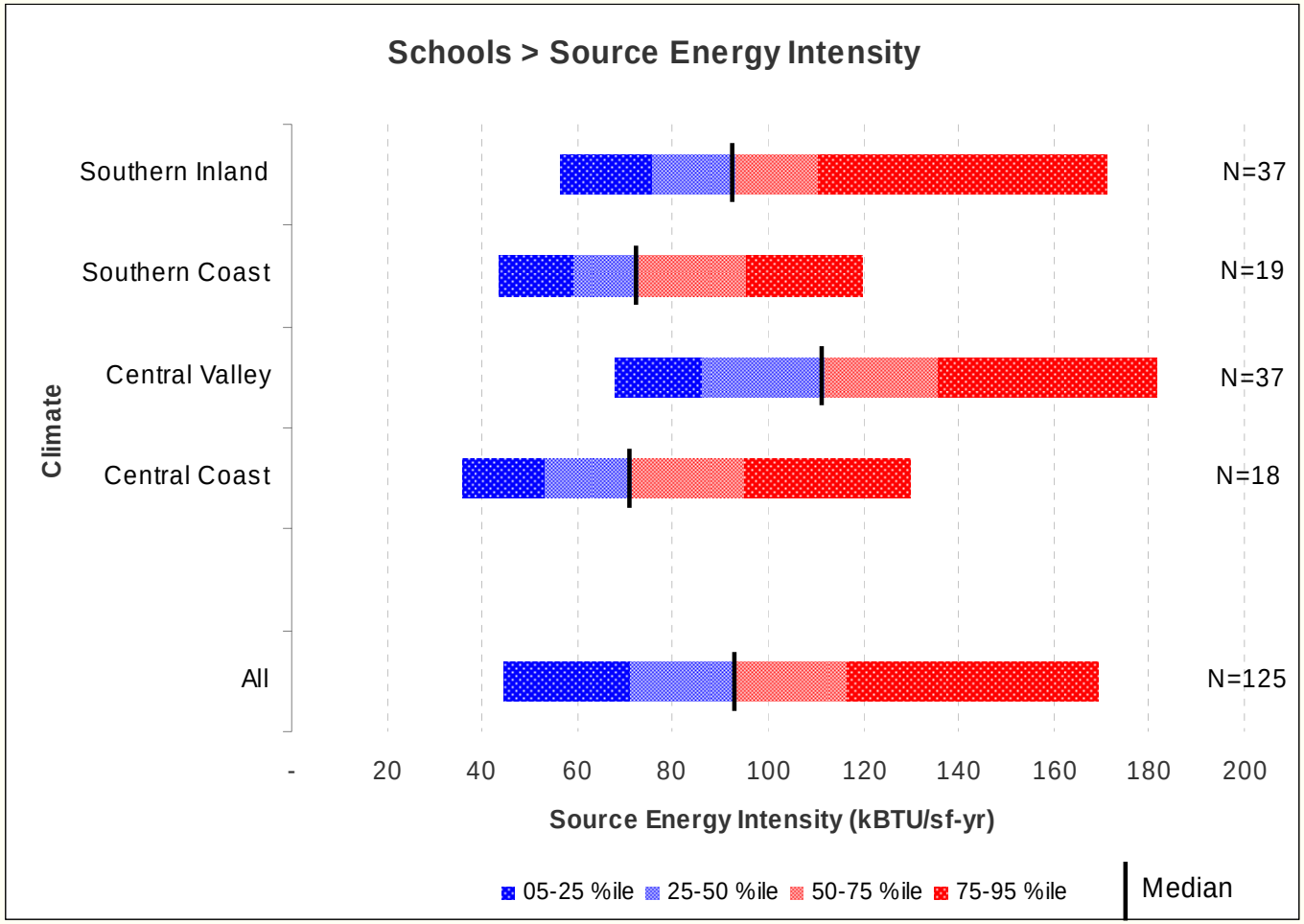
Whole Building Energy Intensity
→ Overall Efficiency Potential



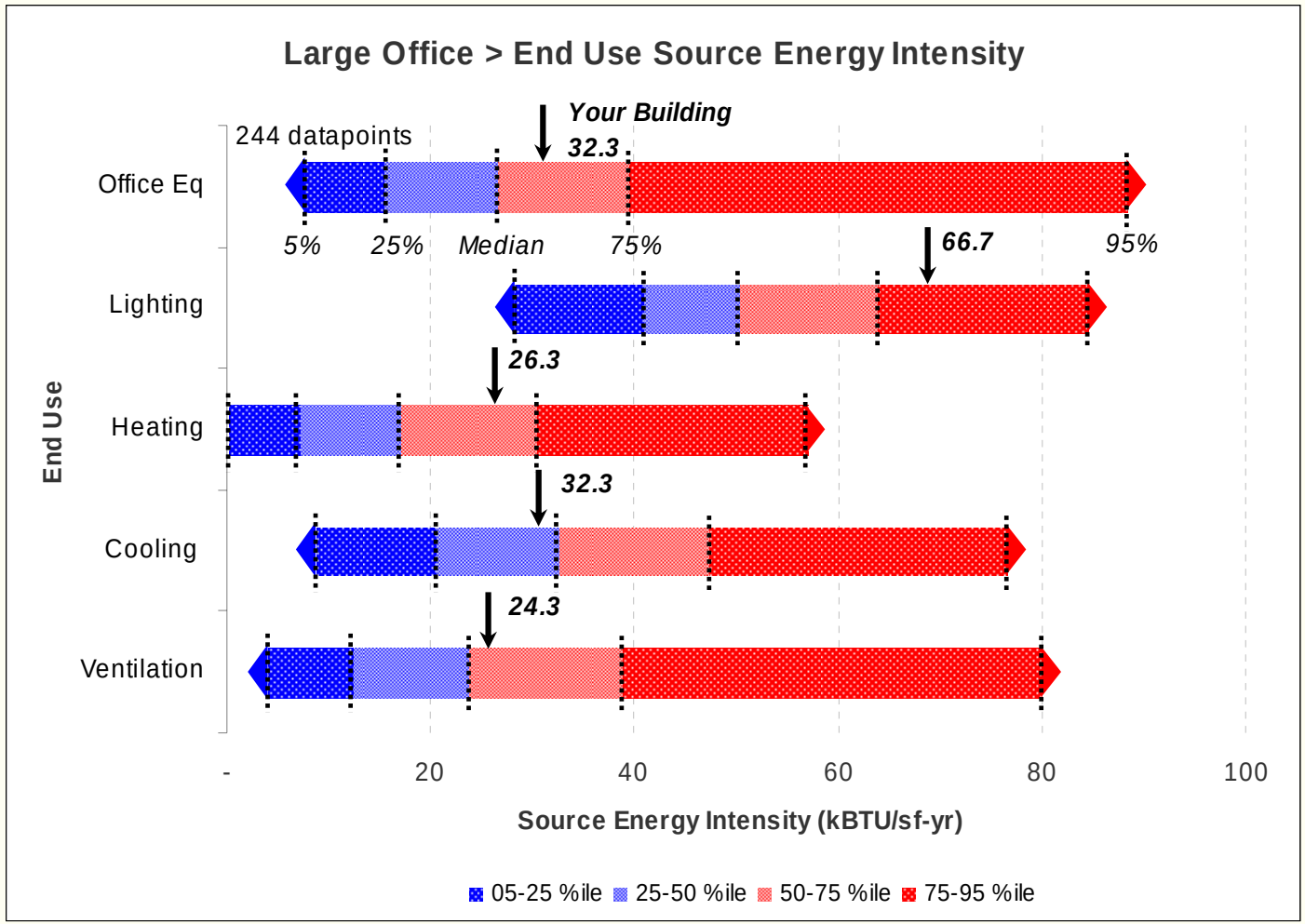
Whole Building Energy Intensity
→ Overall Efficiency Potential by Vintage



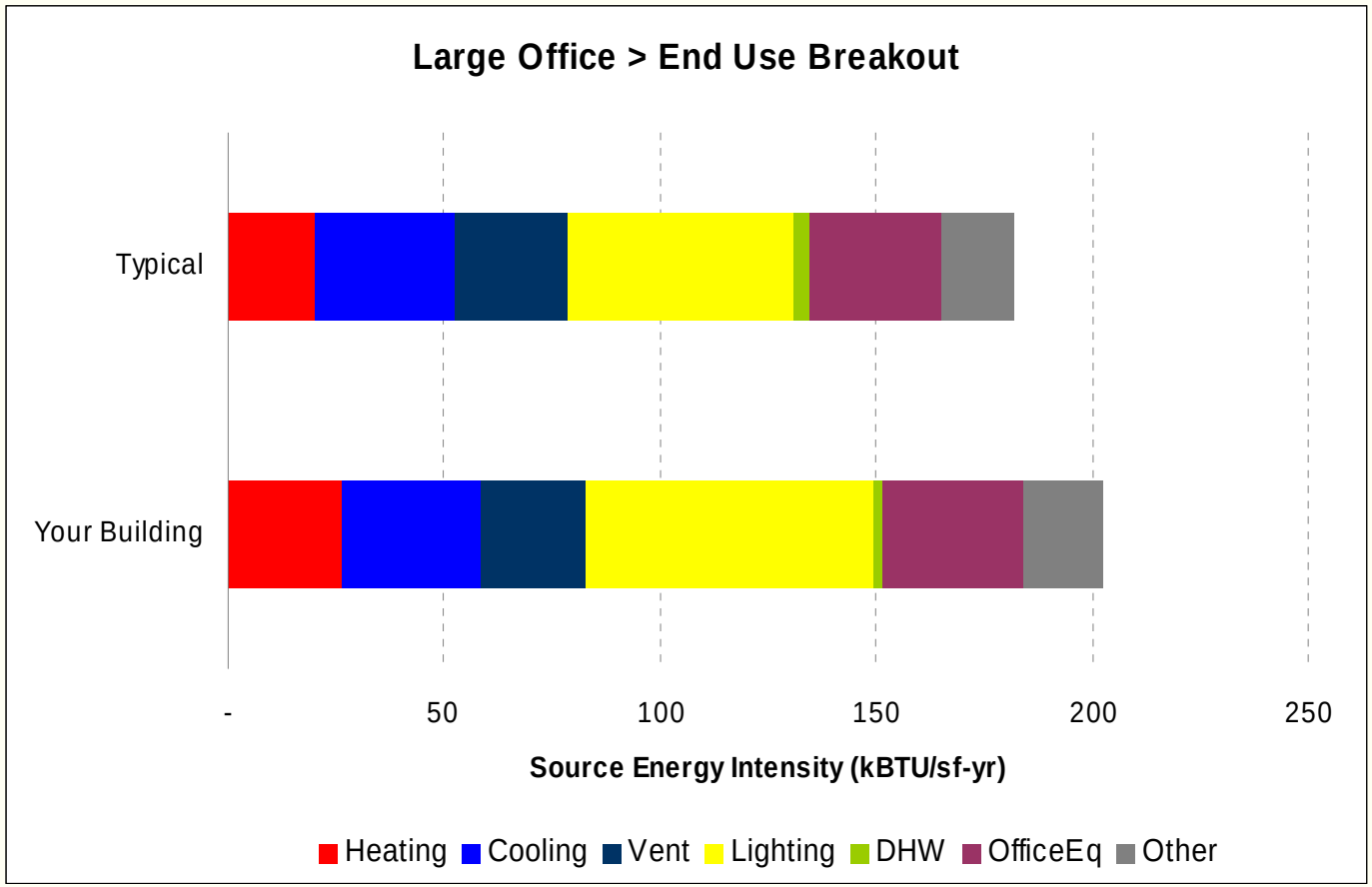
Whole Building Energy Intensity
→ Overall Efficiency Potential by Climate



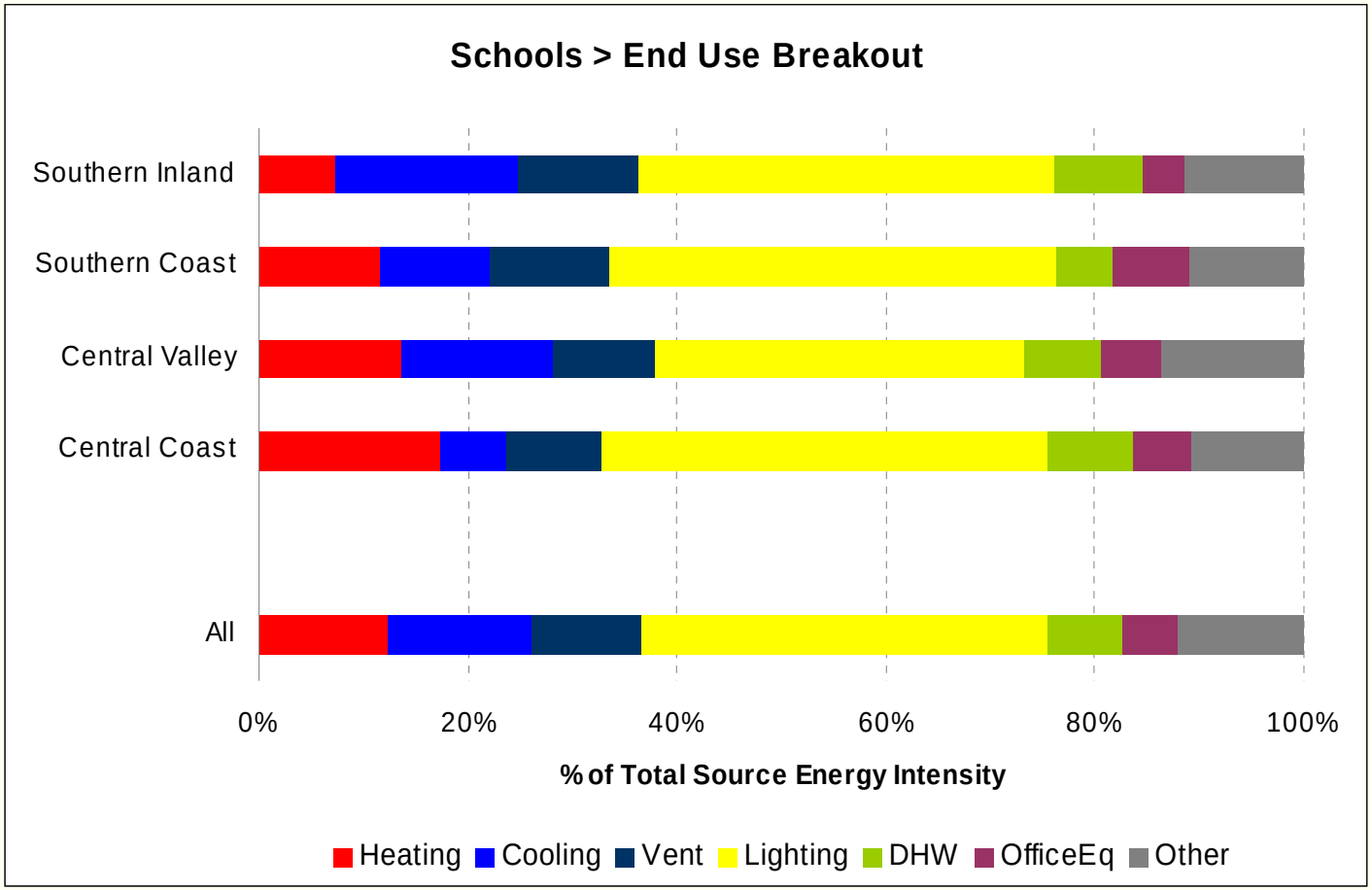
End-Use Energy Intensity
→ System Efficiency Potential



End-Use Breakout
→ System Efficiency Potential and Prioritization

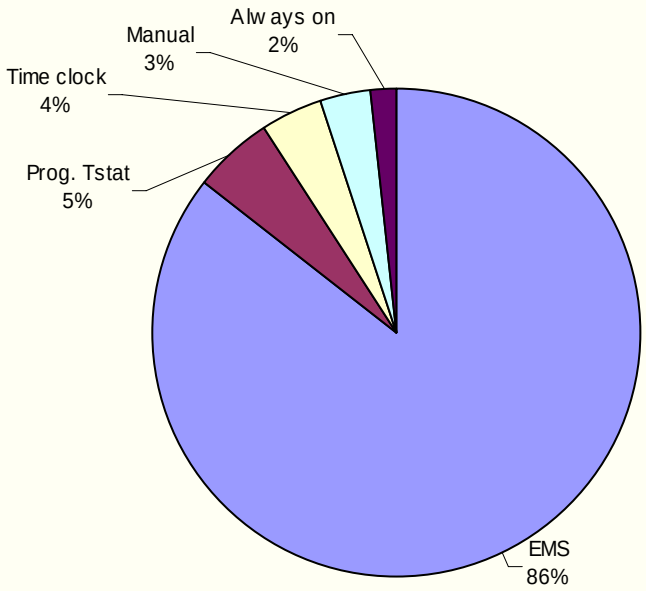


End-Use Breakout
→ System Efficiency Potential and Prioritization

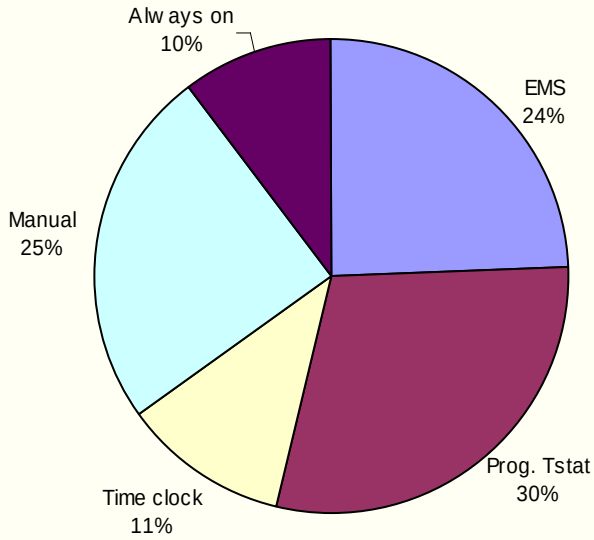


Building Features Benchmarking
→ Identify Potential Actions by Presence/Absence

Large Office > Multi-zone AHU > Temp Control Type
Aggregated by # Systems; N=178 sites, 1676 records

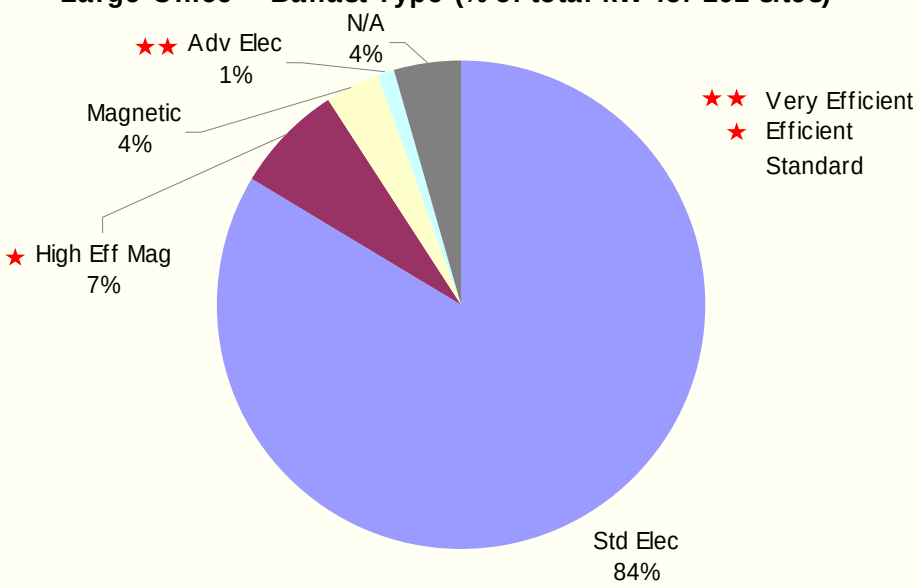


Schools> Single-zone AHU > Temp Control Type
Aggregated by # Systems; N=125 sites, 2395 systems

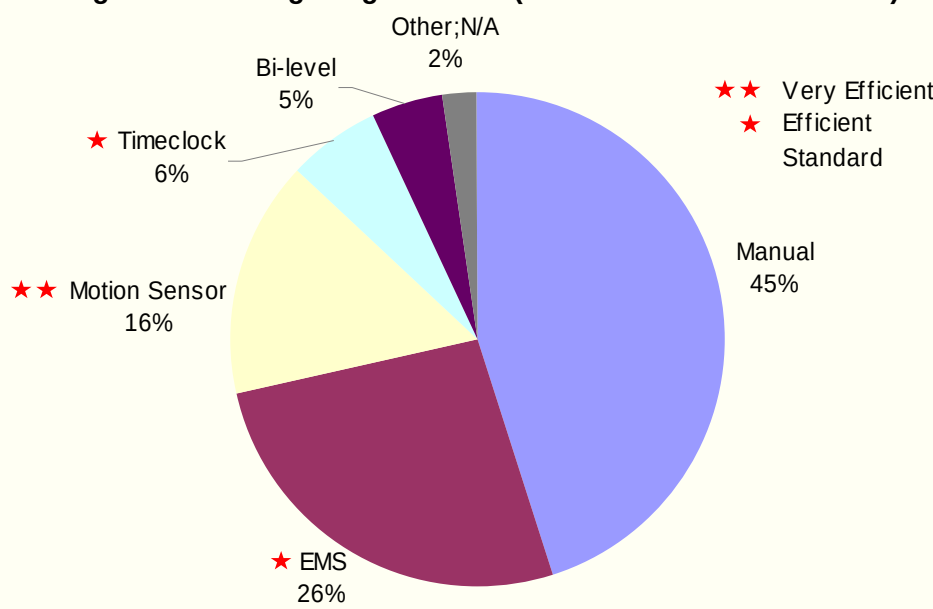


Building Features Benchmarking
→ Identify Potential Actions by Presence/Absence

Large Office > Ballast Type (% of total kW for 292 sites)

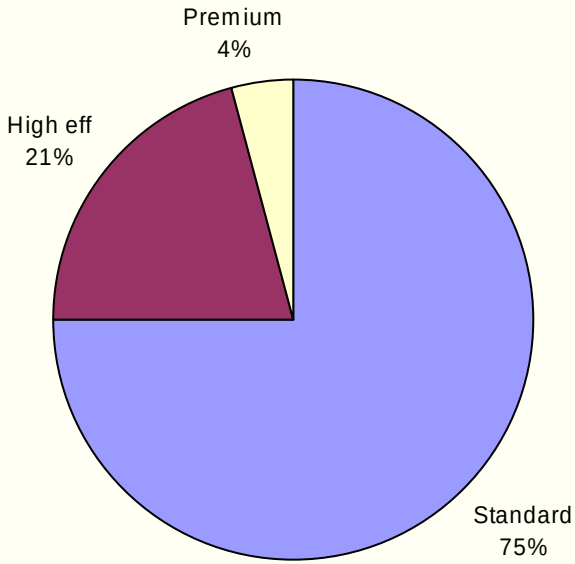


Large Office > Lighting Control (% of total kW for 292 sites)

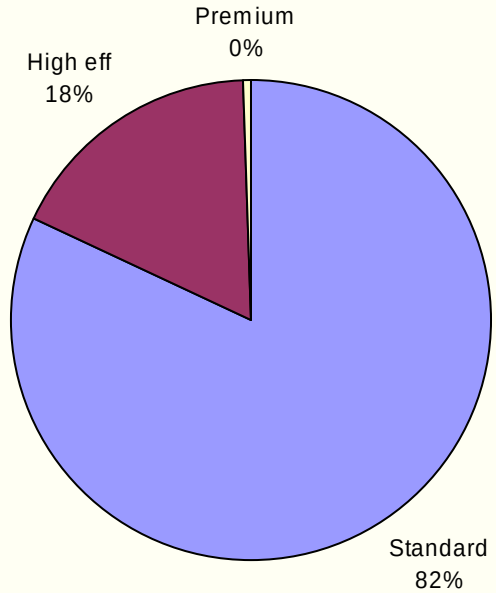


Building Features Benchmarking
→ Identify Potential Actions by Presence/Absence

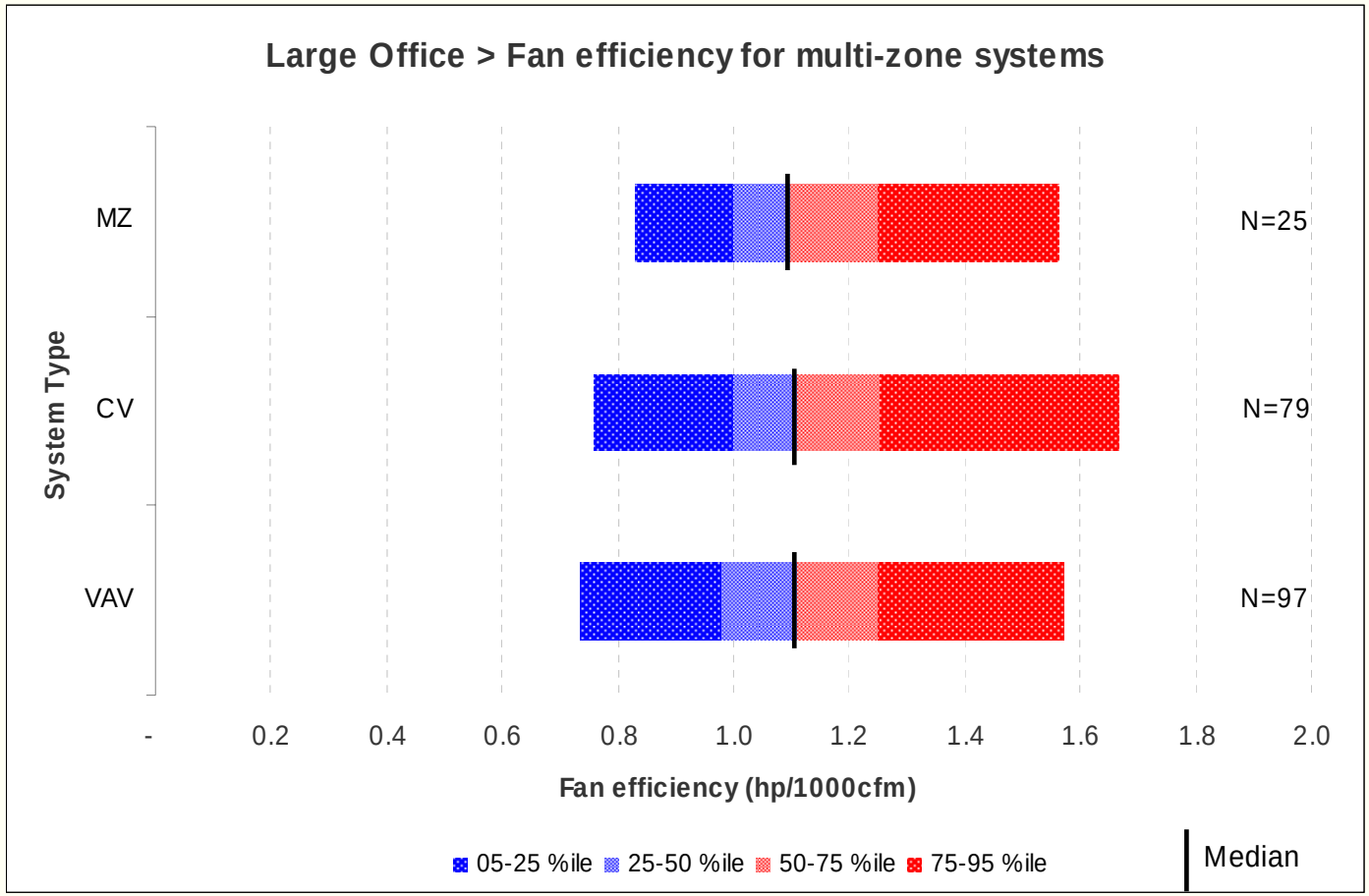
Large Office > Multi-zone AHU > Supply Fan Motor Efficiency
Aggregated by # Motors; N=176 sites, 1911 motors



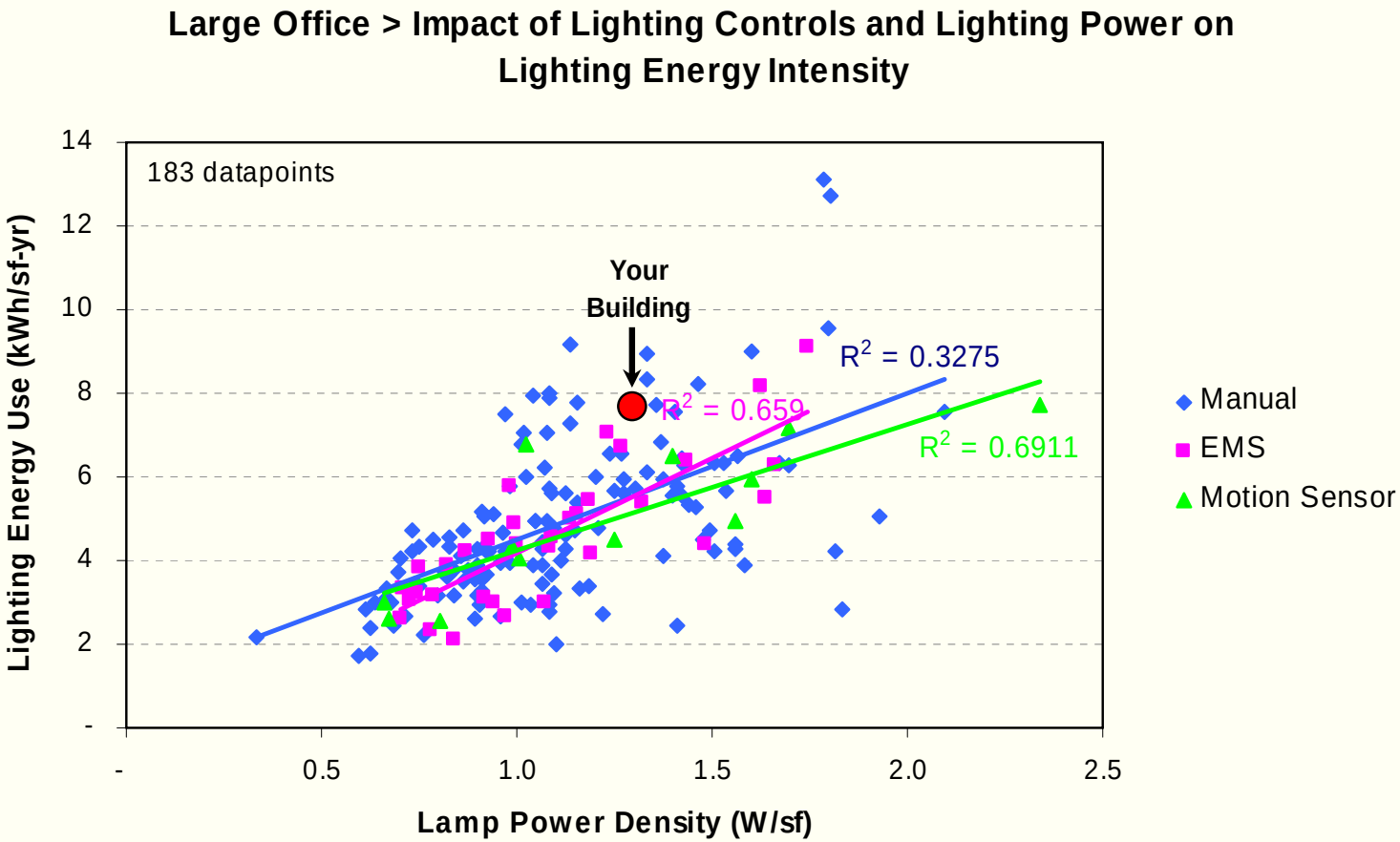
Schools > Single-zone AHU > Supply Fan Motor Efficiency
Aggregated by # Motors; N=123 sites, 2490 motors



Building Features Benchmarking
→ Identify Potential Actions by System Efficiency



Correlating Building Features and Energy Intensity
→ Estimate Potential Savings (sort of)



Limits of AOB

- **NOT "audit in a box"**
  - Only identifies potential actions from predefined list
  - Only crude savings estimates (range)
- Effectiveness is driven by database density
  - Many gaps in CEUS survey data
- Ability to identify actions proportional to user ability to input data

AOB helps identify potential actions and prioritize areas for more detailed analysis and audits

Outlook

- Continued analysis of CEUS
  - Opportunities and limits for AOB
- Development of action inference methodology
  - Mapping list of actions to benchmarking metrics
- Prototype tool currently under development
  - Extensive user surveys to determine features
  - Expected April 2008

Energy IQ

Action-oriented energy benchmarking for non-residential buildings

Benchmark | Actions

V Building type

- ❑ All
- ❑ Small Office
- ✓ **Large Office**
- ❑ Restaurant
- ❑ Retail
- ❑ Food Store
- ❑ Warehouse
- ❑ School
- ❑ College
- ❑ Healthcare
- ❑ Lodging
- ❑ Public Assembly
- ❑ Laboratory
- ❑ Cleanroom
- ❑ Datacenter
- ❑ Mixed Use
- ➢ More choices...

> Location
> Vintage

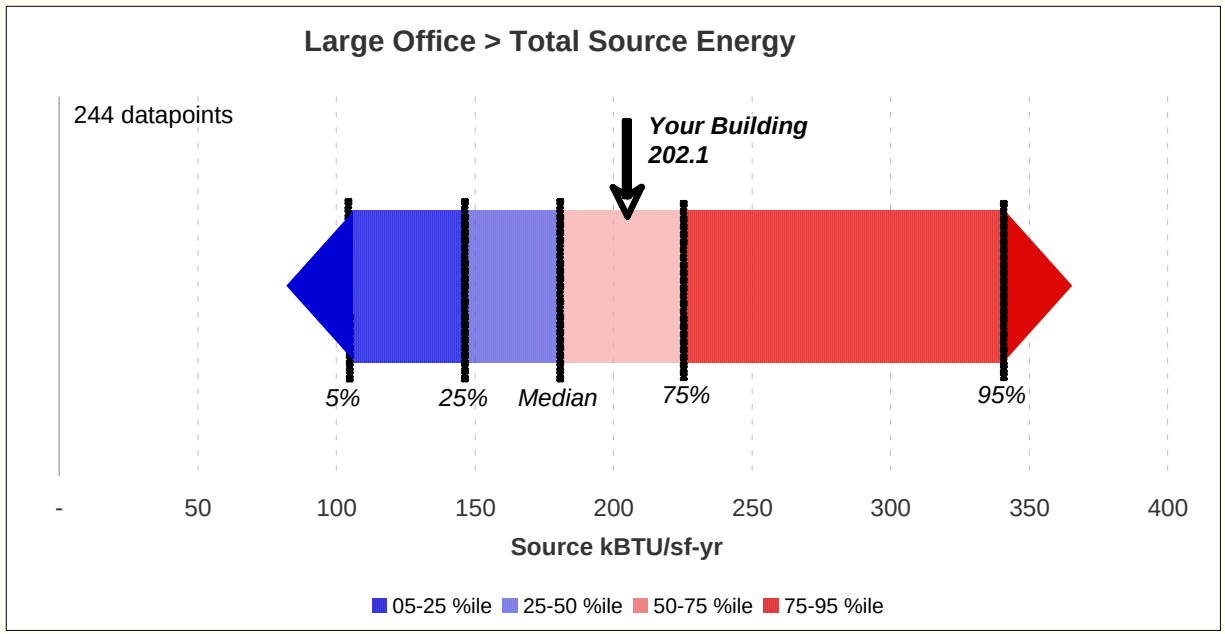
*Or, enter all information in **Project Profile***

To Compare Your Building, Enter:

Conditioned floor area (sf):	100,000
Total energy use	
➢Electricity (MWh):	1000
➢Fuel (MBTU):	100
➢Other (MBTU):	0

Energy, or...	Characteristics & Operations, or	Combinations	Indicators	Views
✓ Total energy	❑ Lighting		✓ Quantity	❑ Summary
❑ Electricity	❑ Envelope		❑ Cost	❑ End Uses
❑ Peak power	❑ Air Handling		❑ Emissions	✓ Distribution
❑ Fuel	❑ Chillers			
❑ Thermal	❑ Boilers			
	❑ Hot Water			
	❑ Plug/Process			

Results: Typical large office buildings use 191 kBTU/ft2-year. Enter your own building information at the left to see how yours compares.



This View: California > large office > total energy > all end uses > **quintiles**
Project Profile: Large Office, California, 100ksf, Electric+Fuel

Questions?

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