Buildings and Behavior

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Office of Federal High-Performance Green Buildings

Climate, Buildings and Behavior Symposium

Garrison Institute

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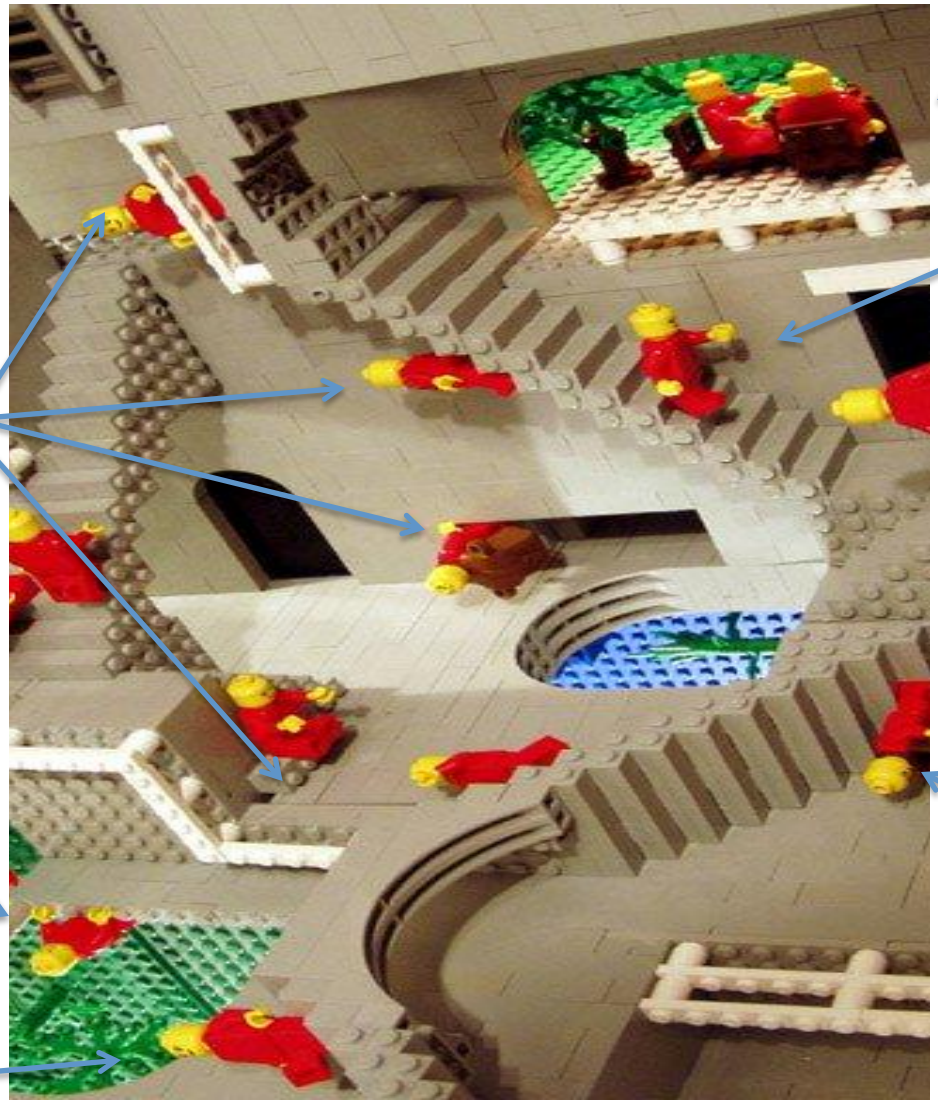
Buildings = ∑ (Behavior)

- GSA's First Energy Reduction Plan/Goals: 1974
- Commercial Buildings in US 1985—2005: *No Change*
- GSA Buildings: 1985—2005: -30%
- All Federal Buildings: -27%
- 1985: Plug load & lighting = 15% Bldg. Energy
- 2010: Plug Load & lighting = 45+% Bldg. Energy

Whose behavior?

Decision makers set the mission & goals



Workers Have different comfort preferences and work styles.

IT person - sets default conditions and IDs technology opportunities

Building Operator – Tracks, adjusts conditions

Purchasing/contracts Makes purchasing decisions

Managers– set performance standards & training

ESPC Net-Zero Challenge









GSA

GSA Challenge Goals

- Demonstrate best practices for maximizing overall ESPC project energy savings;
- Advance progress toward EISA goals;
- Accelerate deployment of underutilized and renewable technologies;
- Further expose GSA regions to new DOE ESPC IDIQ contract process and resulting improvements in ESCO selection;
- Identify and understand processes necessary to get to net zero energy;
- Identify structural, contractual and technical impediments.

What One Change Would You Make?

1. Analysis and Integrated Design

- Integrative, whole building analysis and measures are not commonly included in ESPC's for a variety of reasons including time constraints, risk, confidence in results and unfamiliarity with the process.

2. Project Economics

Barriers	Solutions
1. High Financing Costs (Interest rates)	• Get as close as possible to fed discount rate (.75%) • Create case for gathering support (appeal to broader issues, i.e. jobs, small biz requirements, etc.) • Need to align with Skye's prior efforts
2. No integration with planned improvement projects	• Provide the information ahead of time (RFP or data sharing) • ESCO could fold pre-planned improvement into a larger contract
3. No inclusion of avoided future (>1-2yrs) costs in ESPC (including capital and maintenance)	• Allowed for UESCs but not ESPC's-use similar methodology? • Need clear guidance from central office through to contracting officers
4. LCCA costs do not match contract duration	• Include the LCCA costs (avoided) as NPV • Treat each ECM differently depending on life cycle
5. 1% interest rate difference between UESCs and ESPCs due to guarantee	• Set up insurance fund?

3. ESPC Delivery Process

4. Occupant Behavior

- Energy savings strategies that rely on occupant behavior modifications are rarely part of the ESPC process, and this potential savings is unrealized.

ESPC "Deep Retrofit" Challenge

- 5. Delivery Process
- 6. Measurement and Verification

- Bottom Line:
  TIME IS MONEY

ESPC Challenge Buildings

- 30-35 Buildings
- 18 million sqft
- 100,000 – 800,000 sqft
- $150 million potential project size

What is the Prize?

What Motivates the Companies?

More Business

1.

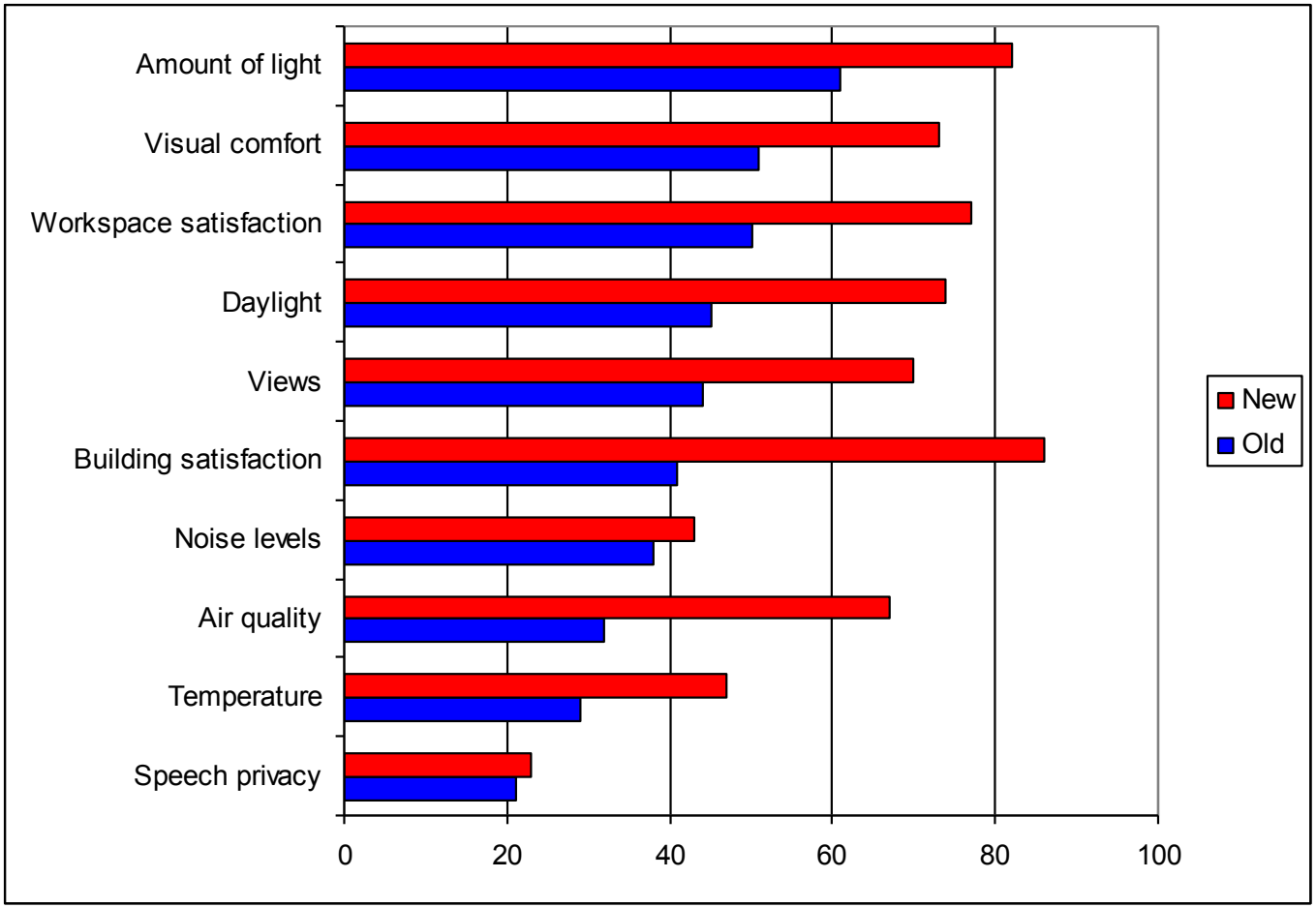
Building/behavior Research Examples

1. Coping with discomfort
2. Desk top plug load behavior change
3. Dual flush toilets and water use

1. Coping with Discomfort

Satisfaction and Comfort

(US General Services Workplace Program)



Percent Satisfied Pre and Post occupancy
(data from approximately 600 occupants)

What do people do when they are uncomfortable or dissatisfied?

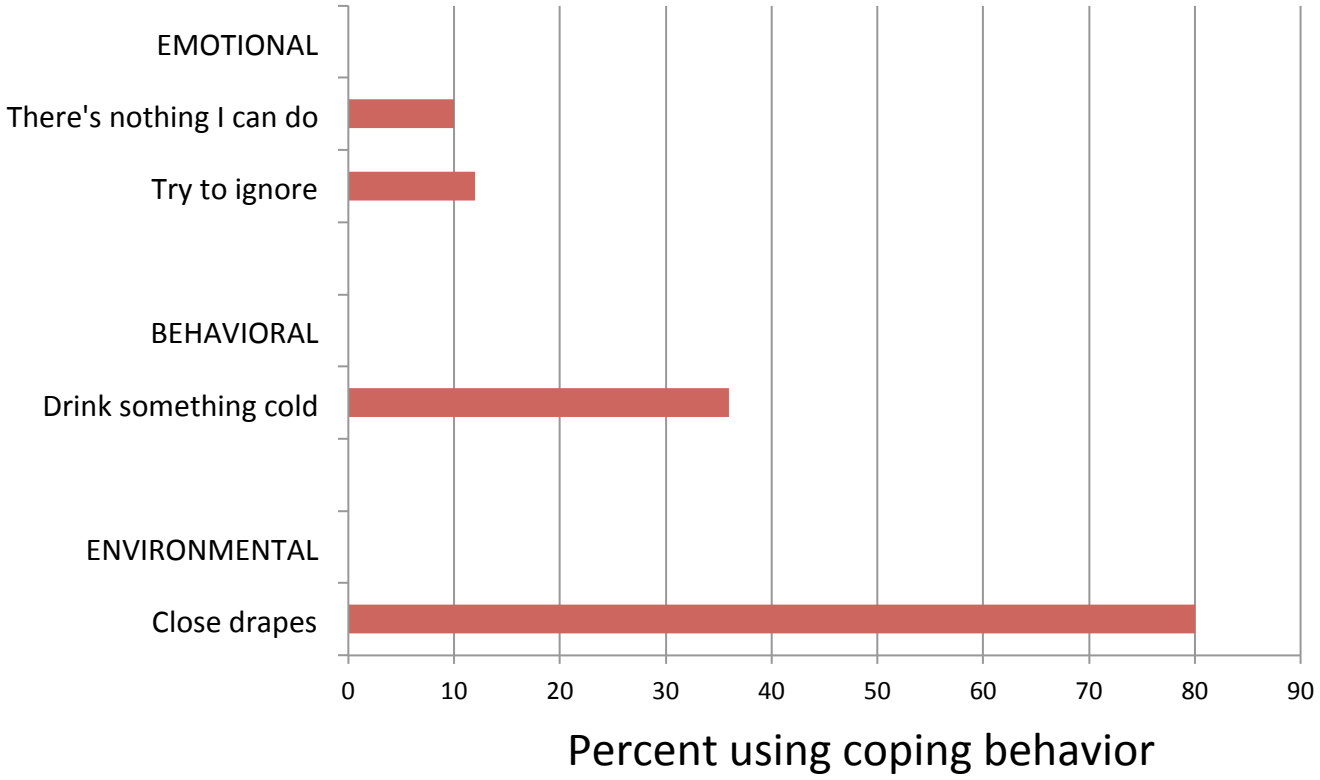
Key Coping Strategies

Change the environment (environmental coping),

Change behavior (behavioral coping),

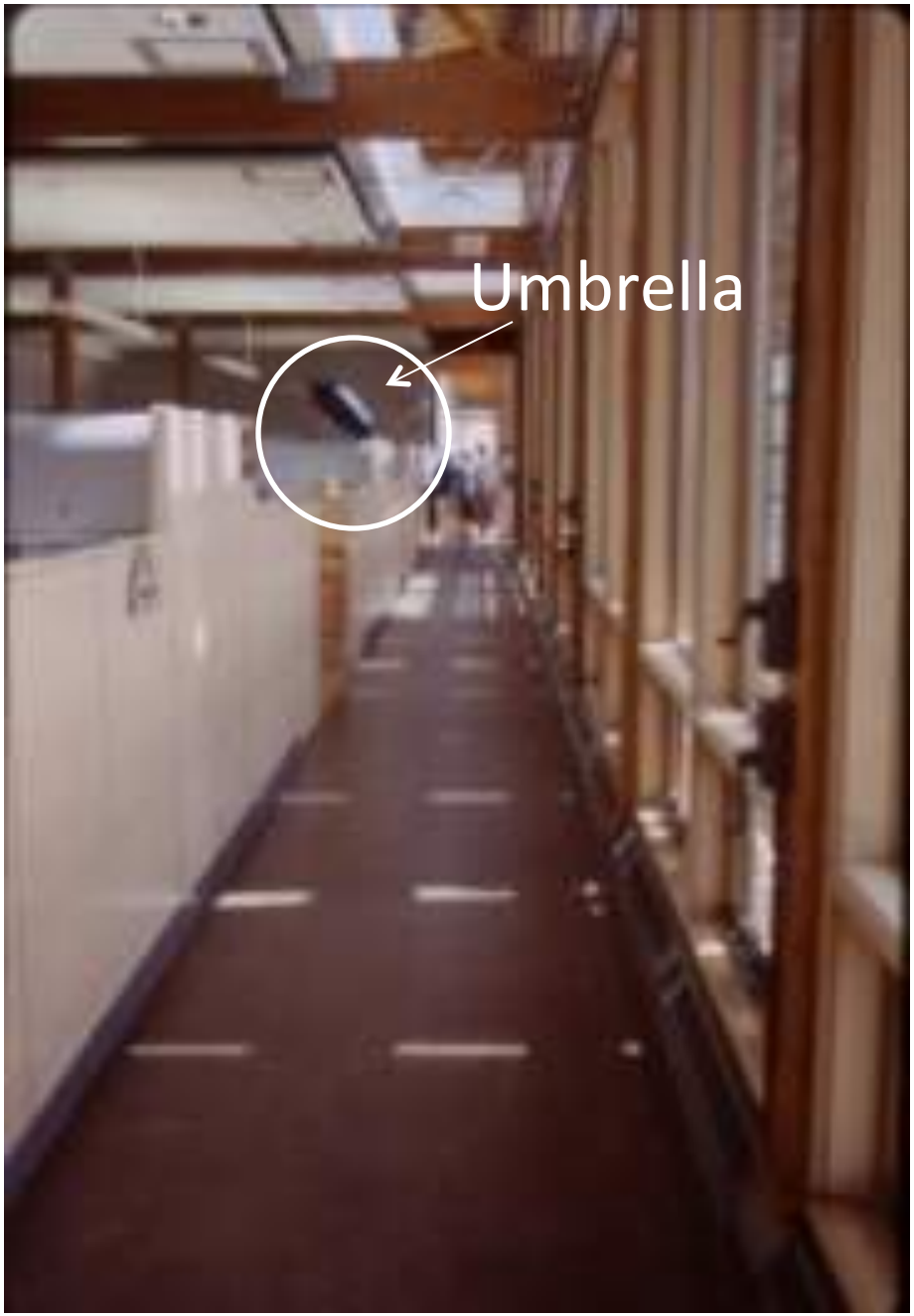
Change feelings (emotional coping)

Daylight discomfort:
Environmental adjustments are most common

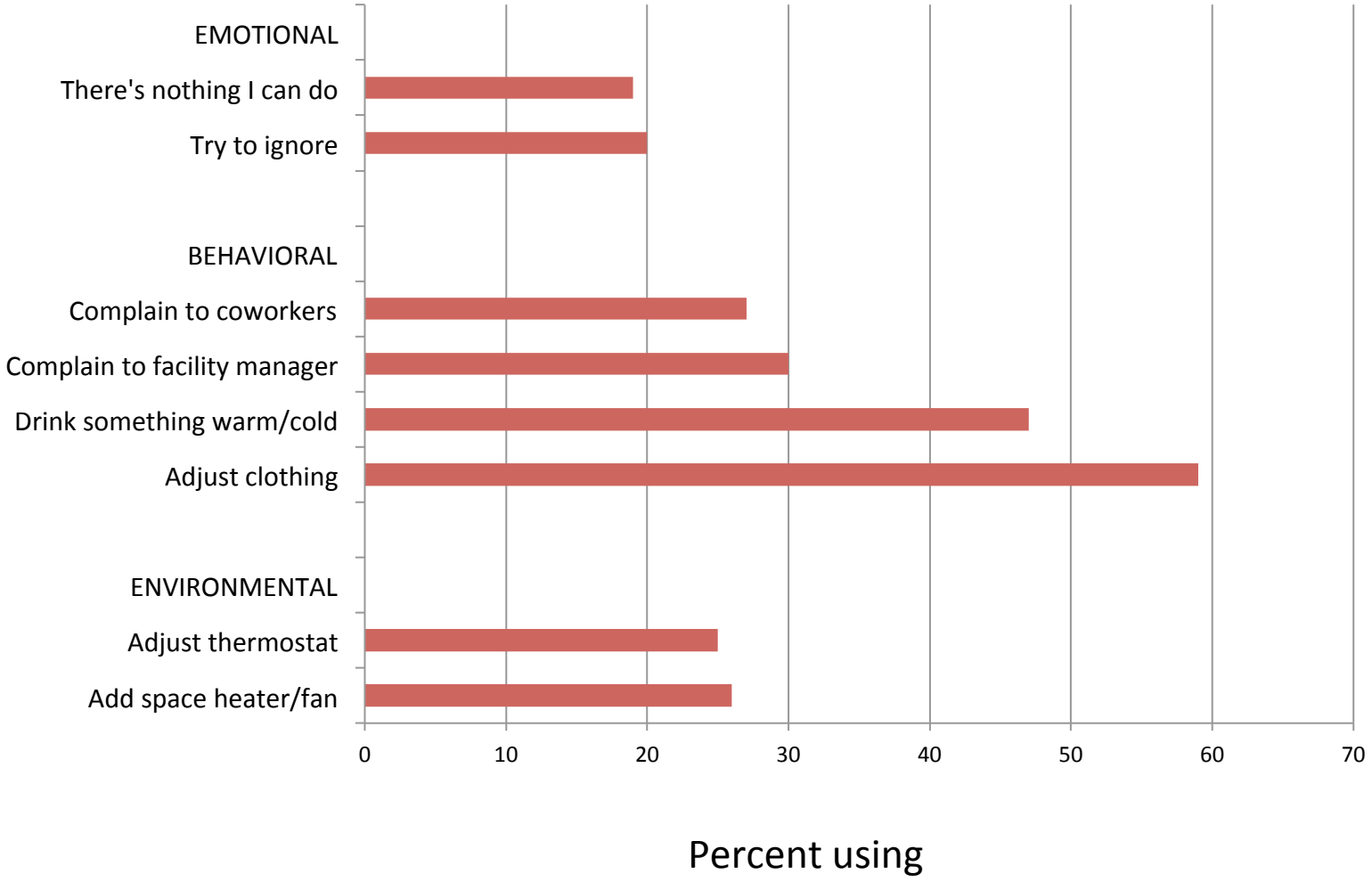


Or, deploy umbrellas when they don't have blinds.

(Phillip Merrill Environmental Center, Annapolis, MD)



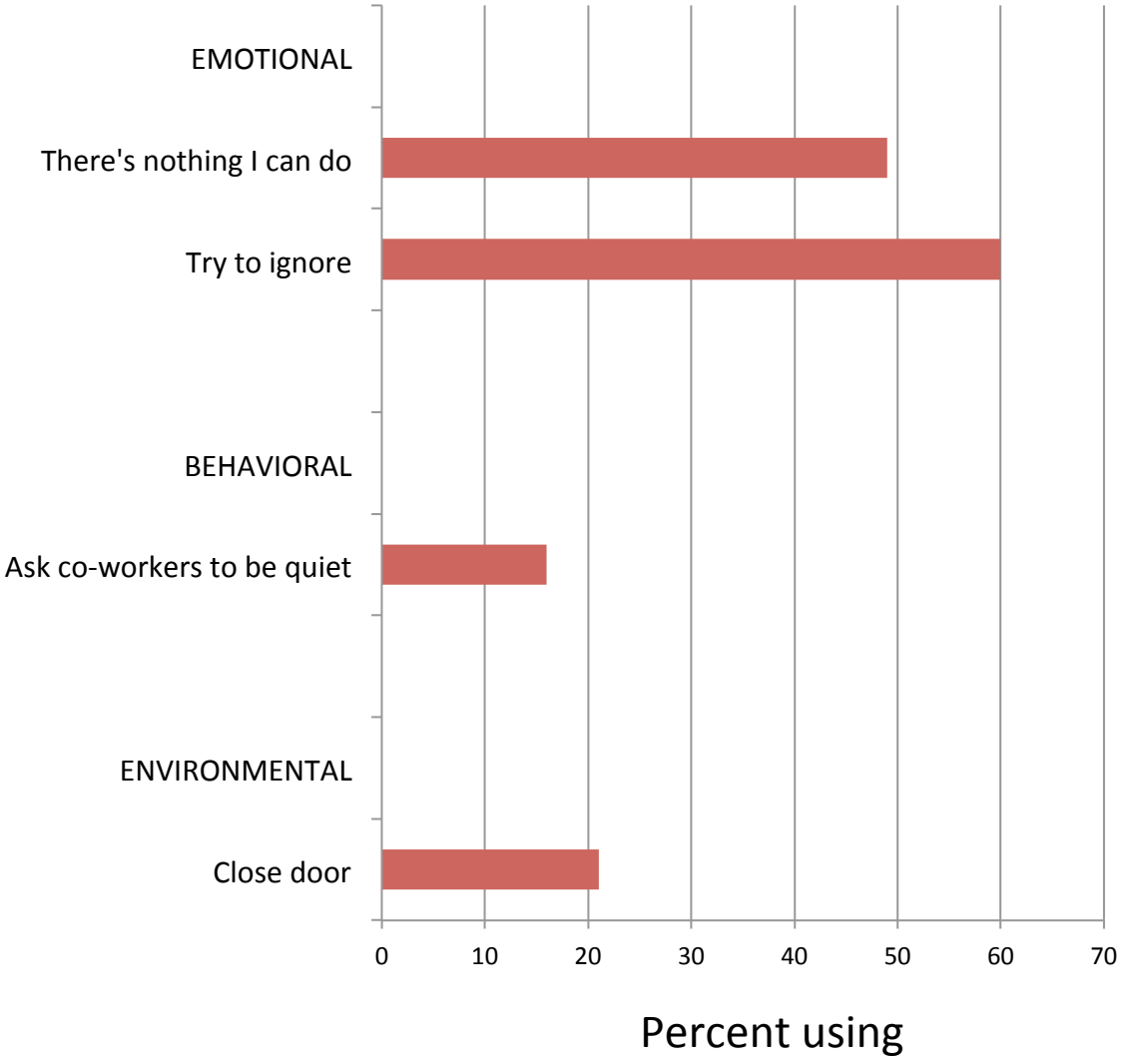
Thermal discomfort:
Behavioral adjustments are most common



But sometimes they cover up vents.

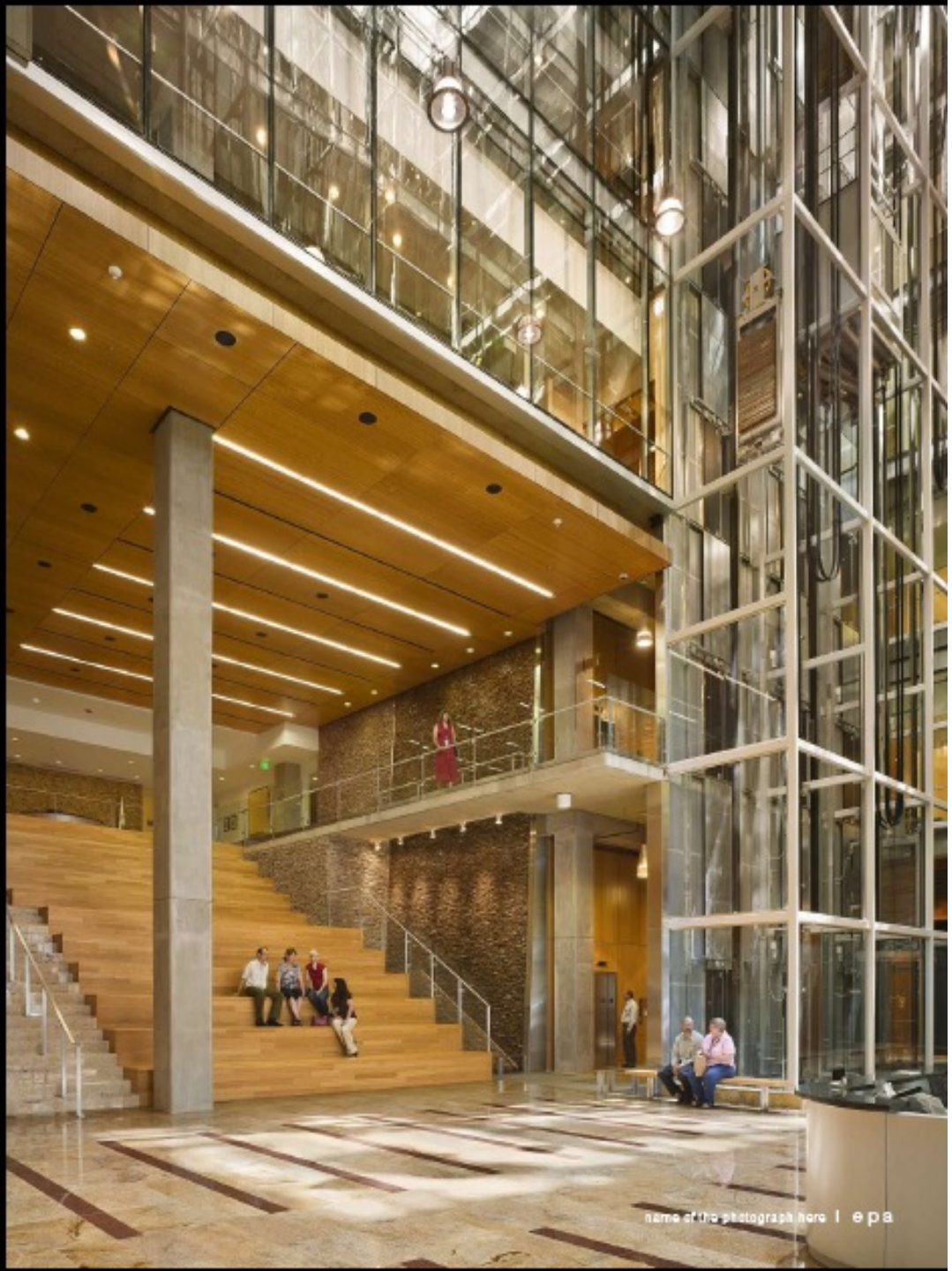
Or, they add devices and keep lights and computers on to increase convenience and comfort.

Acoustics and Privacy:
Emotional adjustments are most common



Adjusting the environment increases probability of improving comfort.

	COPING FOCUS	SUCCESS RATE (e.g. coping effort increases comfort)
	Adjust environment	**85%**
	Adjust behavior	**56%**
	Adjust emotions	**42%**



The EPA Regional Office, Denver

Desk Top Plug Loads

Desktop Plug Load Behavioral Intervention (NREL study)

Three conditions (N=120, repeated measures)

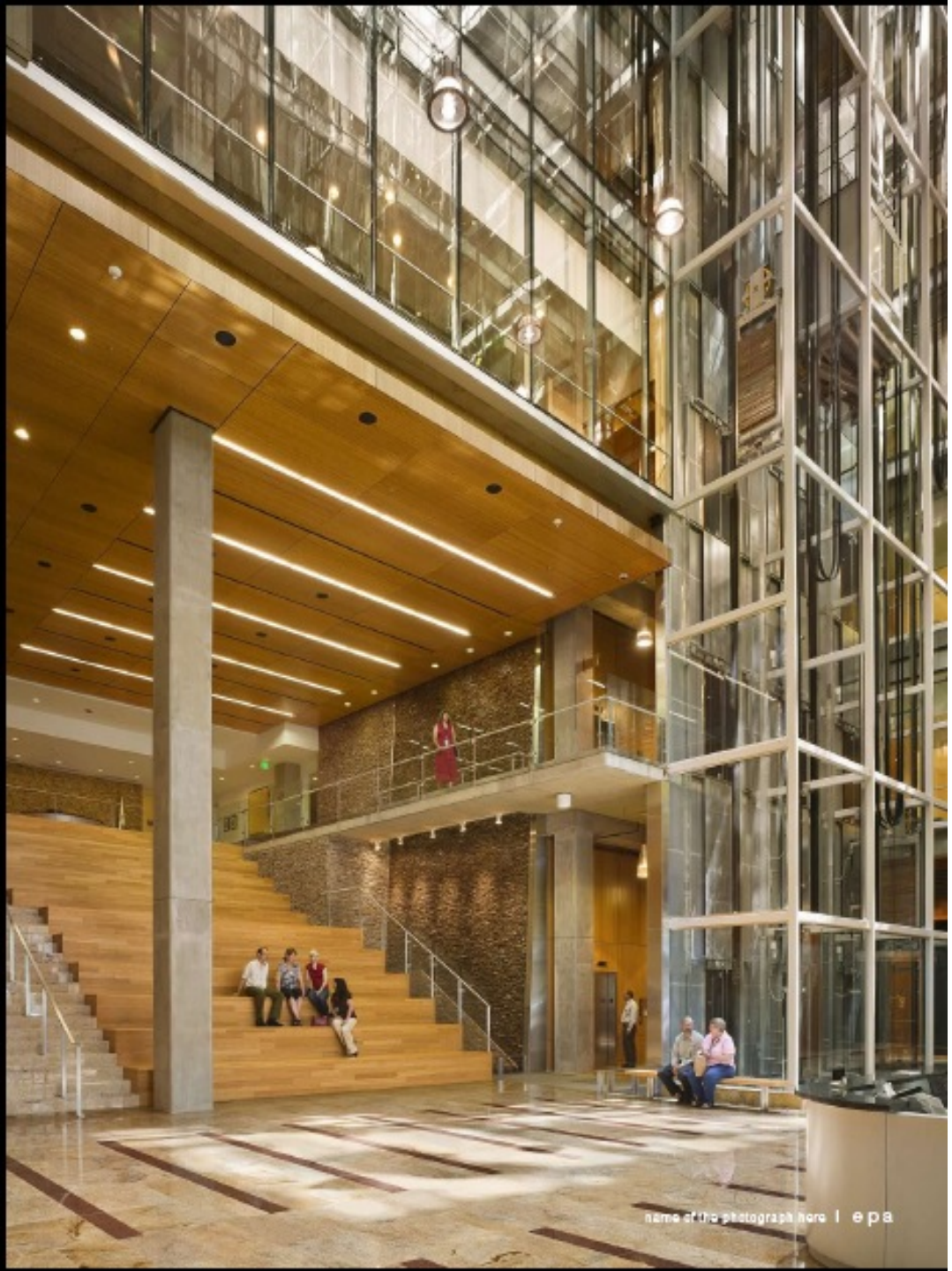
- Automatic turnoff
- Information campaign
- Competition among pods

Use of external dashboard

Energy reductions for each condition + estimated costs

Findings

CONDITION	ENERGY SAVINGS – EXTRAPOLATED TO WHOLE BULIDING (KwH/ YR)	ESTIMATED COST SAVINGS/YR
AUTOMATIC TURNOFF	34,757	$3,476
COMPETITION	9,912	$991
INFORMATION	-407	-41



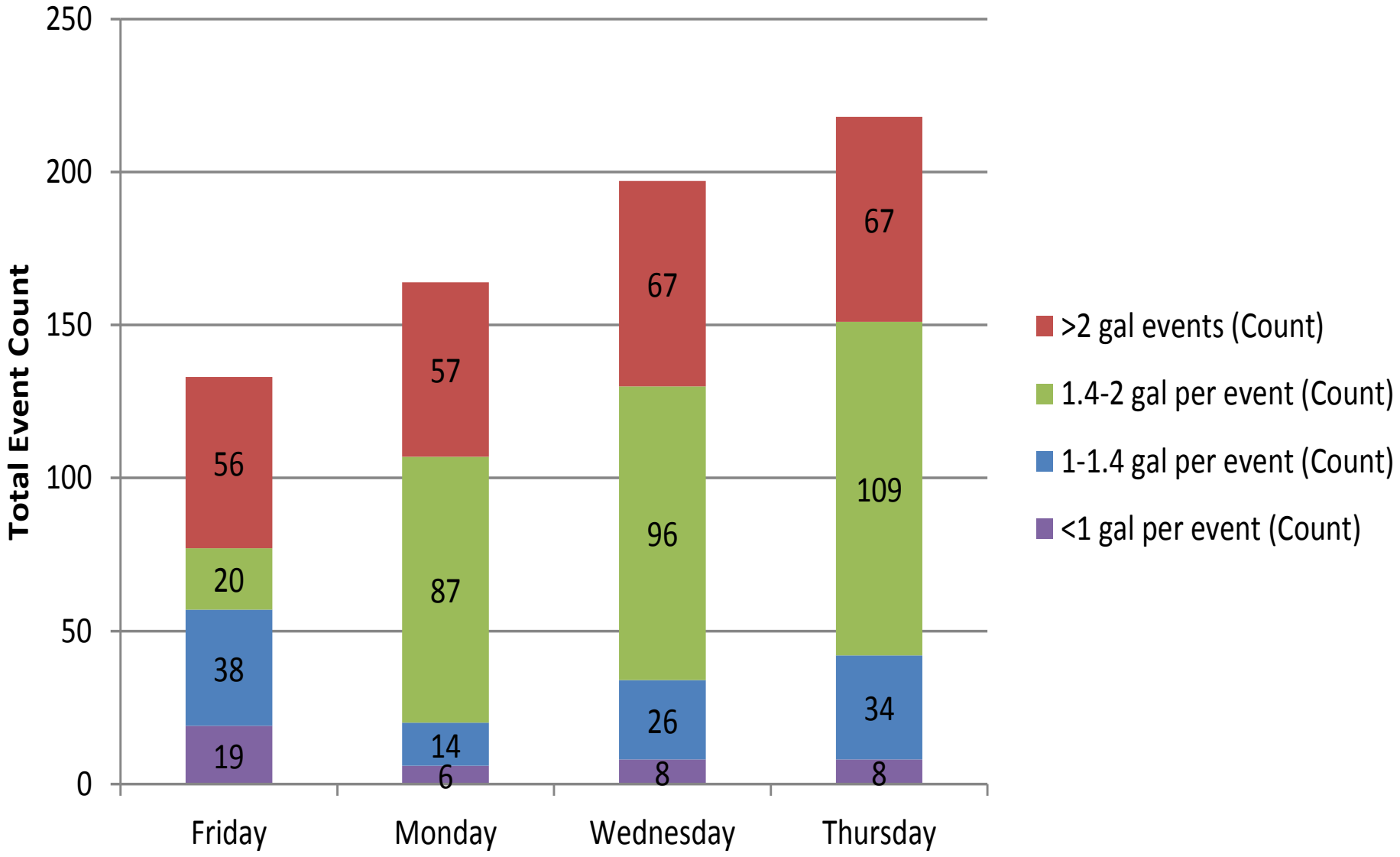
Dual Flush Toilets

RESEARCH FINDING:

Water use from dual flush toilets much higher than anticipated – Why?

Signs told occupants how to use the dual flush toilets.

Wynkoop 7th Floor Water Metering Pre-retrofit
Event occurrences by volume (gallons per event)



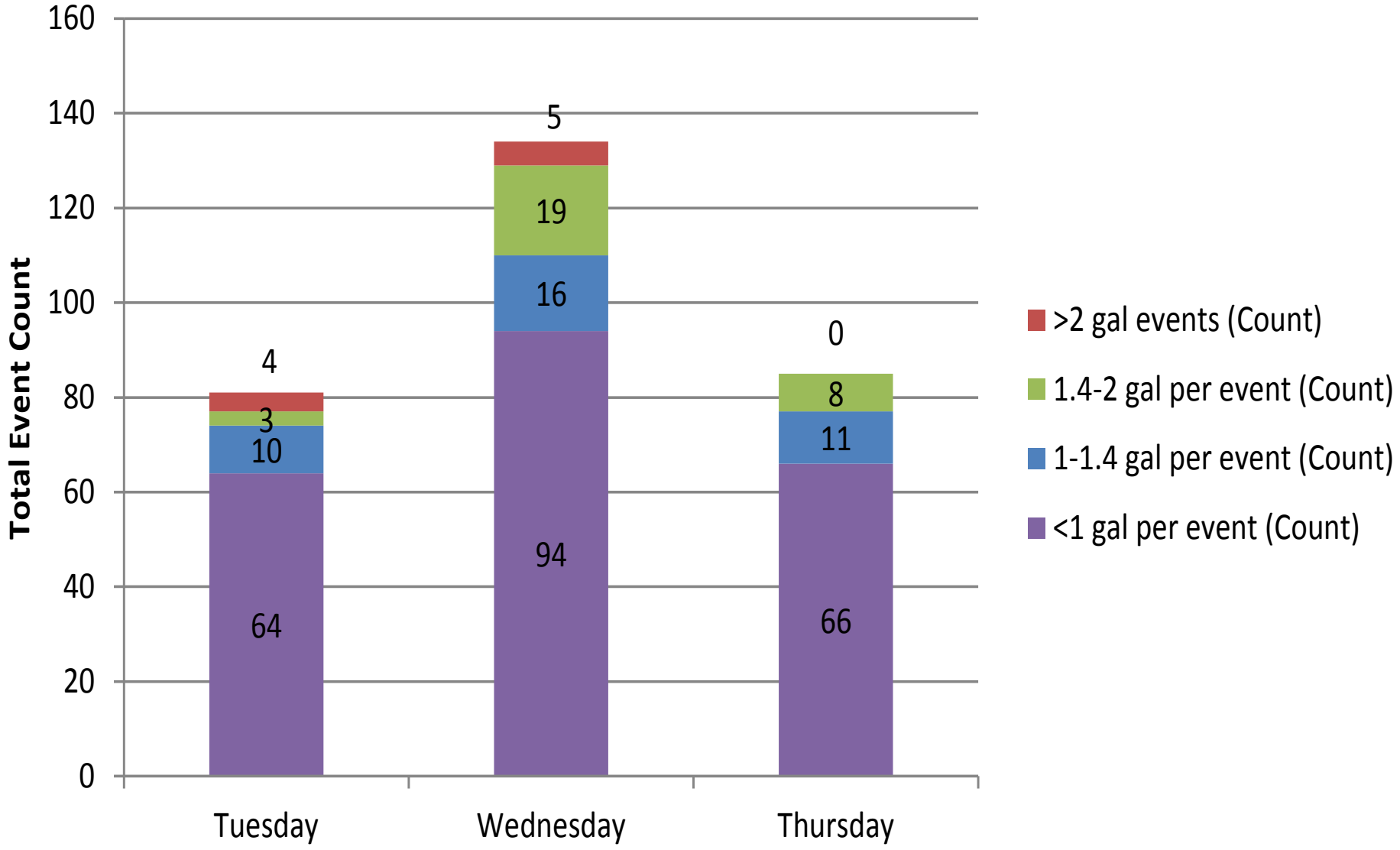
THE PROBLEM:

Habits are hard to change... Even if people read the instructions.

THE SOLUTION:

Handles are easy to change.

Wynkoop 7th Floor Water Metering Post Retrofit
Event occurrences by volume (gallons per event)




Coming Soon –
A GSA toilet-training
YouTube Video

And The Elephant in the Room

We Need To Use Less:

Square Feet