

Mind the Gaps: Post-Occupancy Discoveries from Design to Operation

March 09, 2017
BuildingEnergy Boston

Patrick Murphy, PE, LEED AP BD+C
Chuck Stellberger, PE, LEED AP BD+C



AIA Continuing Education

Please add your name to the sign-in sheet.

NESEA is an AIA-Approved continuing education provider.

- We will report credits earned to AIA CES.
- Course certificates are available upon request.

Agenda

Introduction

What is Post-Occupancy Evaluation?

- Value Proposition
- Process

Case Studies

- Commercial: Parks & People
- Multifamily Residential: Radian
- Science & Technology: Shire Genetics Lab

Wrap-Up / Recap

About the Speakers

Patrick Murphy, PE, LEED AP BD+C

- MEP Project Manager and Senior Mechanical Engineer
- 10 years' experience designing high-performing buildings, including more than 20 LEED projects, including three LEED NC Platinum projects and one net zero off-grid project.



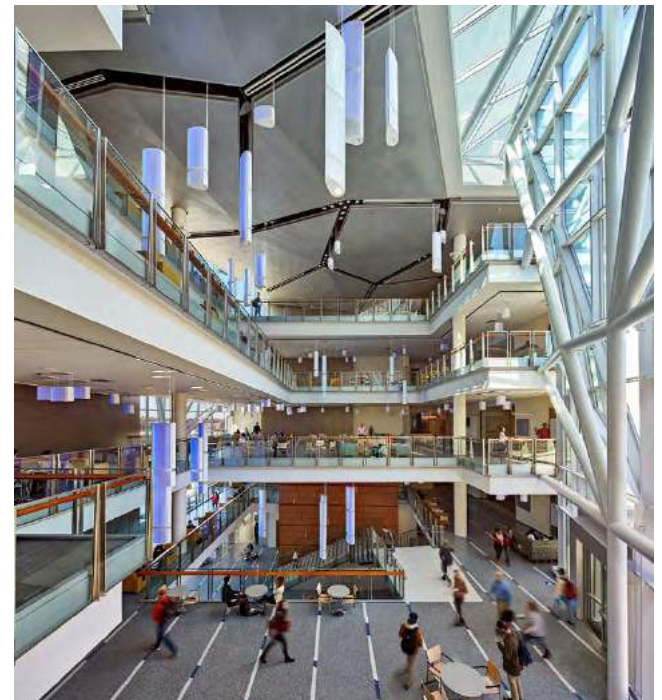
Chuck Stellberger, PE, LEED AP BD+C

- Mechanical Engineer and Energy Modeler
- Energy modeling, energy audits, and sustainability consulting across commercial, laboratory, and healthcare projects, including more than 20 LEED projects.



About the Company

Vanderweil Engineers is a full-service MEP/FP and technology design firm headquartered in Boston with over 400 employees committed to delivering high-performing, sustainable buildings.



Learning Objectives

1. To understand the value proposition of post-occupancy review.
2. To learn the process by which owners and MEP engineers execute a post-occupancy program.
3. To learn about common findings in MEP-based post-occupancy reviews.
4. To understand how the findings from post-occupancy reviews can affect future designs.

Agenda

Introduction

What is Post-Occupancy Evaluation?

- **Value Proposition**
- **Process**

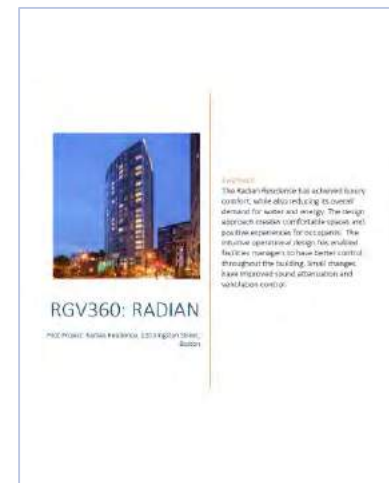
Case Studies

- Non-Profit: Parks & People
- Science & Technology: Shire Genetics Lab
- Multifamily Residential: Radian

Wrap-Up / Recap

What is Post-Occupancy Evaluation (POE)?

- POE is a high-level evaluation of MEP system performance and overall occupant experience.
- The project team revisits the site 1-3 years after substantial occupancy.
- The project team issues a report summarizing findings and makes recommendations for improvement.



Value Proposition: Client

- Engages the design team during/beyond the warranty period
- Enhances owner understanding of their building and design intent
- Provides recommendations for improved operations
- Outlines corrective actions for issues



Value Proposition: Design Team

- Solicits candid feedback on building design, maintainability, and performance
- Analyzes real-life performance data to evaluate design decisions
- Follows up on commitments made by the project (EUI, IEQ metrics, etc.)



Value Proposition: Design Team

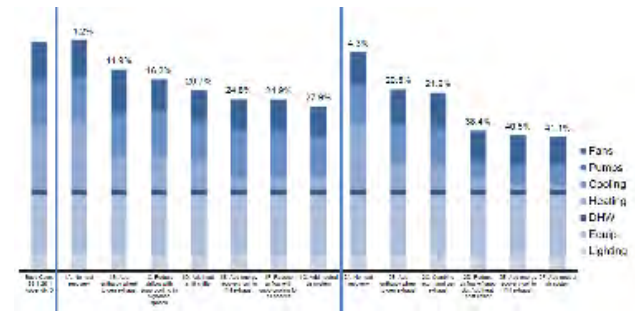
- Incorporates lessons learned into future designs
- Deepens the client relationship
- Opportunities to conduct energy audits and retrocommissioning



How is POE Different From...

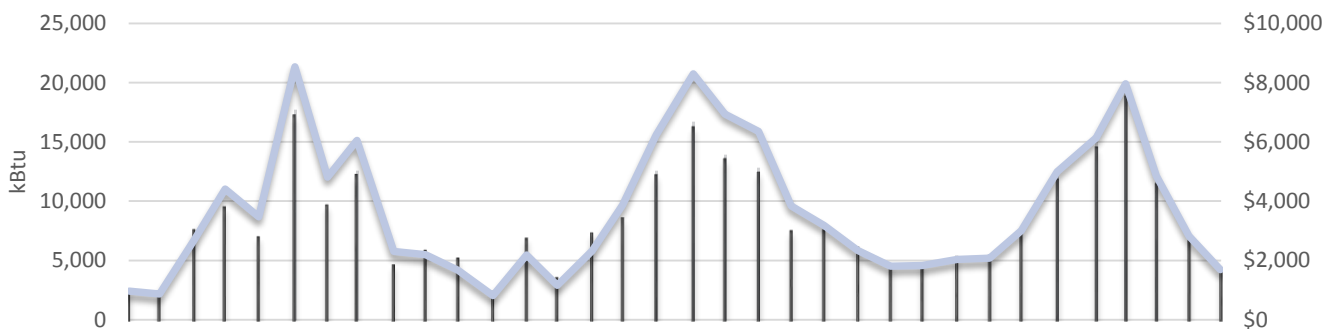
- ...M&V or an energy audit?
 - POE is not focused solely on energy consumption
 - POE does not include energy model calibration
- ...retro-commissioning?
 - POE occurs before retro-Cx
 - POE does not alter system operations

POE is a higher-level and shorter process than either of these activities.



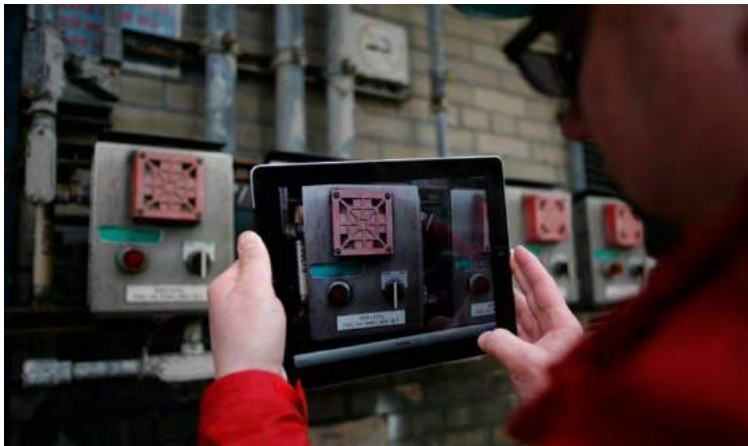
POE Process

- Follow up with the owner 1-3 years after occupancy
- Outline POE process and value proposition
 - Send questionnaire
 - Request utility data
 - Schedule site visit
- Evaluate utility data, compare to energy model



POE Process

- Conduct site visit:
 - Interview owner and occupants
 - Interview facilities staff
 - Inspect the building systems



POE Process

- Issue report with findings and corrective actions
- Follow up with owner to review findings and next steps

POE Process

Questionnaire and Interviews

- Building controllability and complexity
- Equipment maintenance and warranty issues
- Energy performance
- Physical installation
- Project closeout & training
- Occupant comfort
- Overall occupant experience

Assessment Area	Score (out of 5)	Notes
General System Performance:	★★★★	
Building Controllability:	★★★★	Controls issues stem from the user interface and the interaction between the master controls and the individual system control.
Energy Performance:	★★★★	The Energy performance has not been calibrated with the model. However, the overall energy use is for the whole building is tracking in line with the model.
Physical Installation:	★★★★	There have been few issues with actual installation. However, the water heater was placed in a way that has made the access to instantaneous hot water slightly limited. The hot water takes a few minutes to occur in the showers that are across the building.
Project Closeout:	★★★★	The building has been well maintained although the controls specialists have not been easy to be in contact with. A potential next step would be to work with BGE to determine whether lighting rebates are available.
Occupant Experience:	★★★★★	The occupants have been very satisfied with room-level thermal comfort, temperature control, and layout. The light/glare has been an issue occasionally but the shades can be drawn and tend to allay the problem.

POE Process

Report and Follow-Up

- Document questionnaire and interview findings
- Provide analysis of energy performance vs.
 - Modeled design
 - Similar buildings (i.e. Benchmarking)



POE Process

Report and Follow-Up

- Suggest corrective actions
- Review lessons learned
- Celebrate what went right!



Agenda

Introduction

What is Post-Occupancy Evaluation?

- Value Proposition
- Process

Case Studies

- **Non-Profit: Parks & People**
- Science & Technology: Shire Genetics Lab
- Multifamily Residential: Radian

Wrap-Up / Recap

Case Study # 1

The Sally & Butch Michel Center for Parks and People
Baltimore, MD



Case Study # 1

Center for Parks and People



Parks and People is a Baltimore non-profit which works to revitalize neighborhoods and communities through hands-on cleaning and greening of the natural environment.



**PARKS &
PEOPLE**
FOUNDATION

Case Study # 1

Center for Parks and People



- Historic renovation of Park Superintendent House
- New construction of offices and community rooms



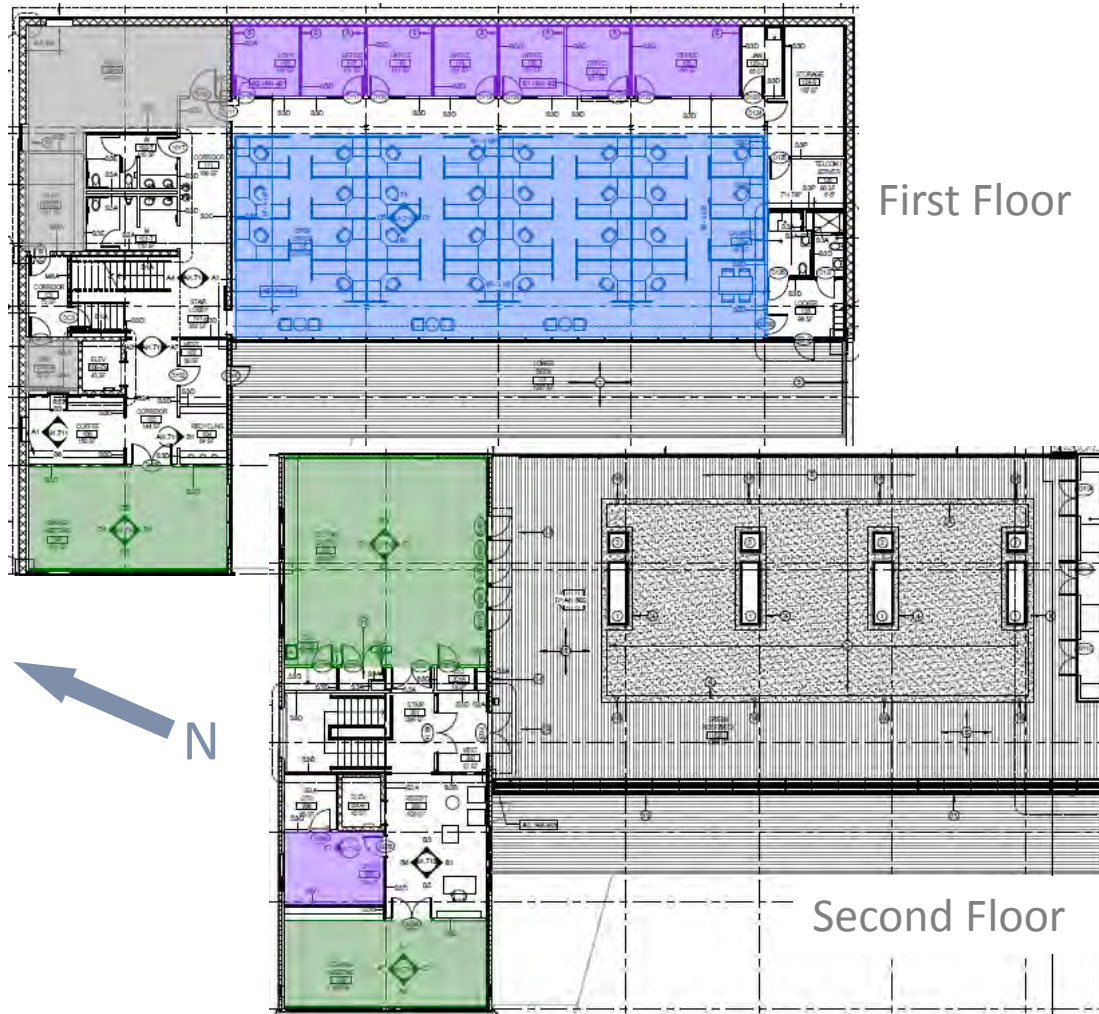
Headquarters building (10,000 SF)



Superintendent's building (4,700 SF)





Case Study # 1

Center for Parks and People



First Floor

Second Floor

-  Private Office
-  Open Office
-  Conference
-  Mech/Elec

Case Study # 1

Center for Parks and People



Energy Conservation Measures:

- High-performance envelope
- Green Roof
- Low Flow Plumbing Fixtures
- Composting Toilets
- Photovoltaic Array
- Electrical vehicle charging station
- Daylighting optimization
- Geothermal Variable Refrigerant Flow (VRF) System
- Natural ventilation
- Energy recovery ventilation
- Expanded thermal comfort conditions



Case Study # 1

Center for Parks and People



Certified LEED Platinum!

- 49.3% energy cost savings compared to ASHRAE 90.1-2004
- Energy Star score of 100
- Metered energy use of 43.1 kBtu/ft² (March 2015 through February 2016)

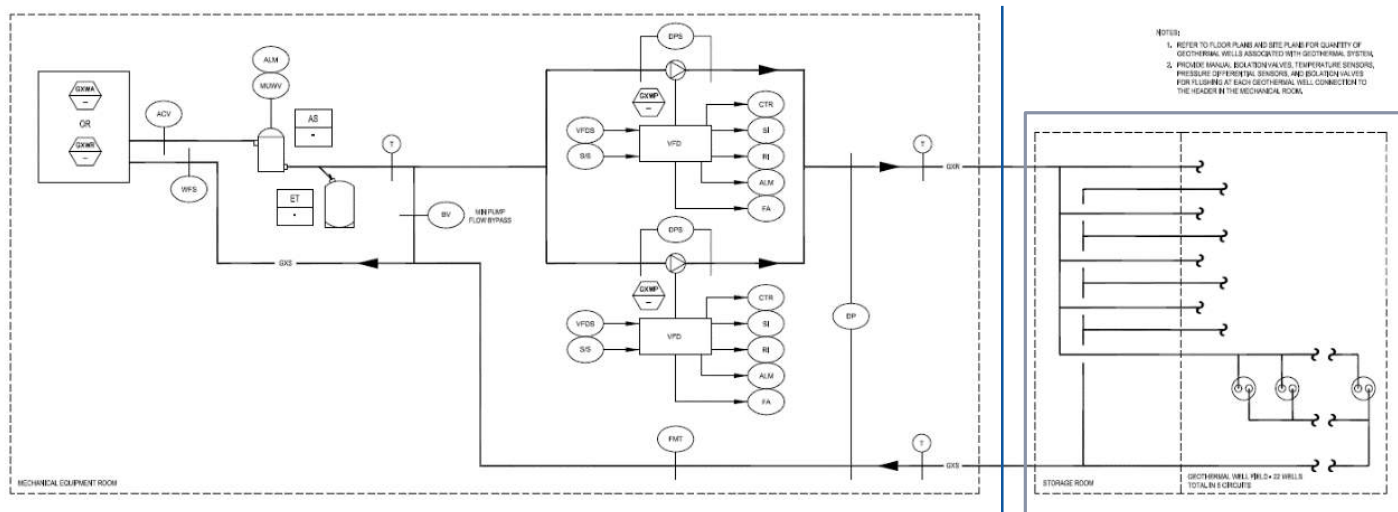


Case Study # 1

Center for Parks and People



- Mechanical Highlights:
 - Geothermal VRF system
 - Natural ventilation backed up by mechanical energy recovery ventilation



Building-side-loop

Geothermal wellfield

Case Study # 1

Center for Parks and People



- Electrical Highlights:
 - PV array
 - CFL lighting
 - Daylight optimization

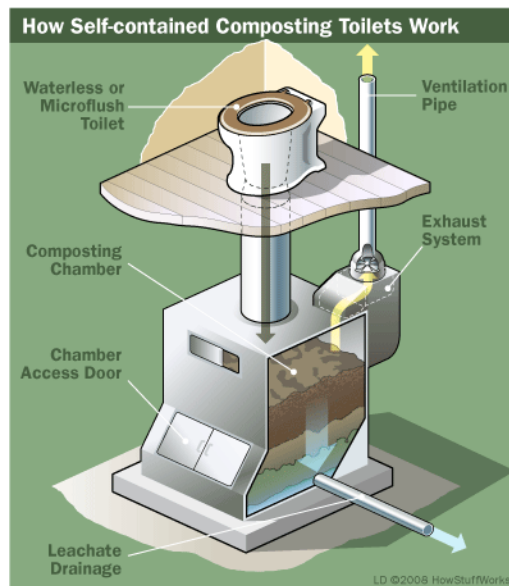


Case Study # 1

Center for Parks and People



- Plumbing Highlights:
 - Low-flow fixtures
 - Composting toilets in the Superintendent's building

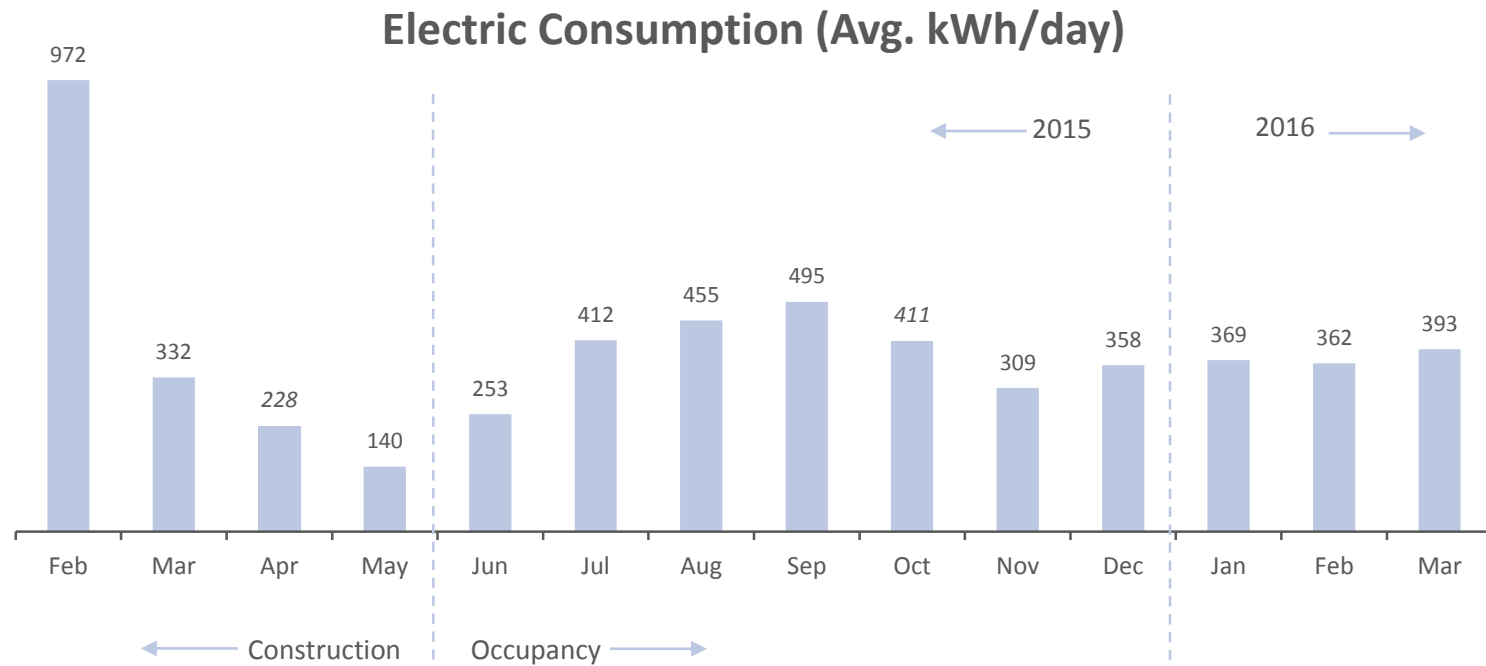


Case Study # I

Center for Parks and People



Utility Data Analysis:

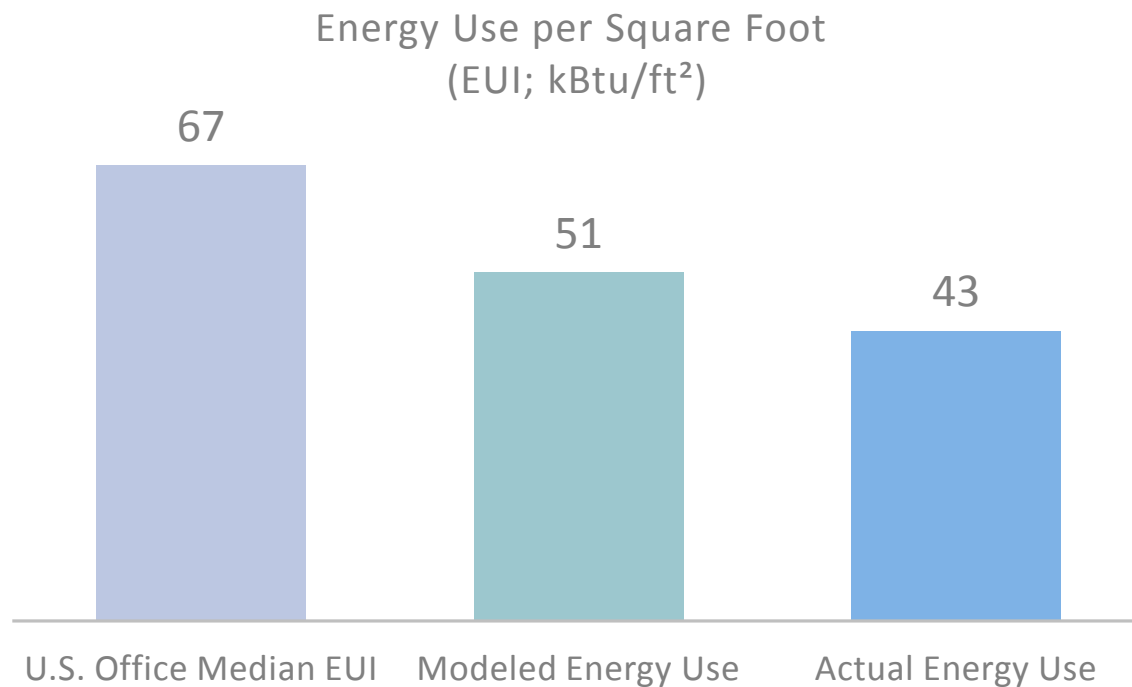


Case Study # 1

Center for Parks and People



Utility Data Analysis:



Case Study # 1

Center for Parks and People



POE Highlights:

- The organization is thrilled overall with their new building
- Thermal comfort in open office, conference, and corridor spaces
- Daylight and views
- Headquarters building energy use

Case Study # 1

Center for Parks and People



Issues raised:

- Occupant comfort in private offices
- Superintendent's house A/C use
- Ceiling fan control
- Groundwater pump shut-off
- Composting toilets



Case Study # 1

Center for Parks and People



Lessons Learned:

- Thermal comfort
- Contractor availability and training
- Composting toilets: design vs. actual frequency of use
- Occupants moving into a new building are generally satisfied, but there is always room for improvement.

Agenda

Introduction

What is Post-Occupancy Evaluation?

- Value Proposition
- Process

Case Studies

- Non-Profit: Parks & People
- **Science & Technology: Shire Genetics Lab**
- Multifamily Residential: Radian

Wrap-Up / Recap

Case Study #2

Shire Pharmaceuticals: Genetics Laboratory

Lexington, MA



Case Study #2

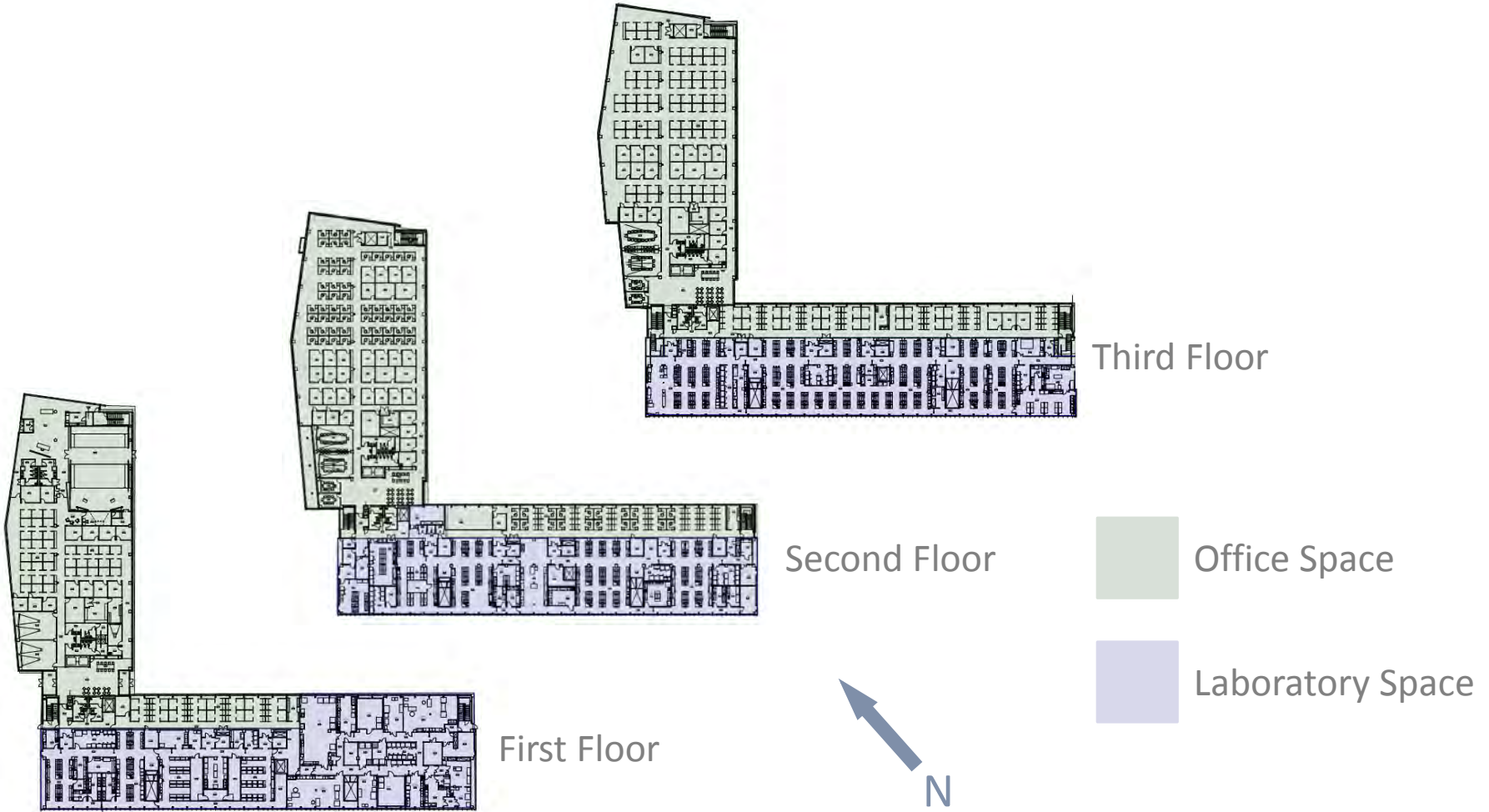
Shire Genetics Laboratory

- Lexington, MA
- 190,000 ft² over four stories
- Completed in 2012



Case Study #2

Shire Genetics Laboratory



Case Study #2

Shire Genetics Laboratory



Mechanical Highlights:

- Heat-shift chiller
- Chilled beams in lab spaces
- Low-pressure air distribution design
- Laboratory exhaust energy recovery
- Condensing boiler plant



Case Study #2

Shire Genetics Laboratory



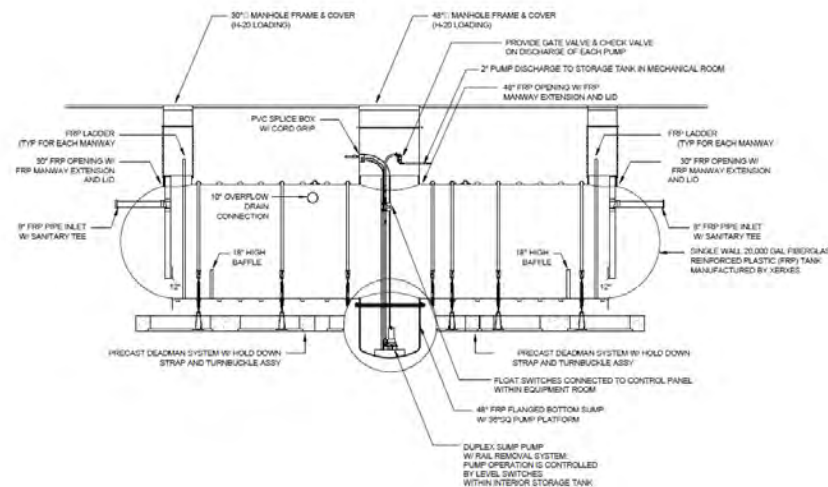
- Electrical Highlights:
 - Lighting power density reduction
 - Daylighting control
 - High process loads ranging from 5-60 W/ft² in each room
For context, offices typically have loads of 2 W/ft²

Case Study #2

Shire Genetics Laboratory



- Plumbing Highlights:
 - Rainwater collection for cooling tower makeup and toilet flushing
 - RODI reject/reclaim system
 - pH neutralization system



Case Study #2

Shire Genetics Laboratory



POE Highlights

- Sound attenuation — far exceeded owner's expectations
- Chilled beams functioning as intended
- Lighting levels in laboratories



Case Study #2

Shire Genetics Laboratory



Issues raised and lessons learned:

- Humidity control in laboratory spaces
- Snow entering the OA intake
- Energy recovery unit shifts into and out of economizer mode
- Importance of commissioning process

Agenda

Introduction

What is Post-Occupancy Evaluation?

- Value Proposition
- Process

Case Studies

- Non-Profit: Parks & People
- Science & Technology: Shire Genetics Lab
- **Multifamily Residential: Radian**

Wrap-Up / Recap

Case Study #3

The Residences at Radian Boston

Boston, MA



Case Study #3

Radian Boston



- 300,000 ft², 26-story mixed-use residential high-rise

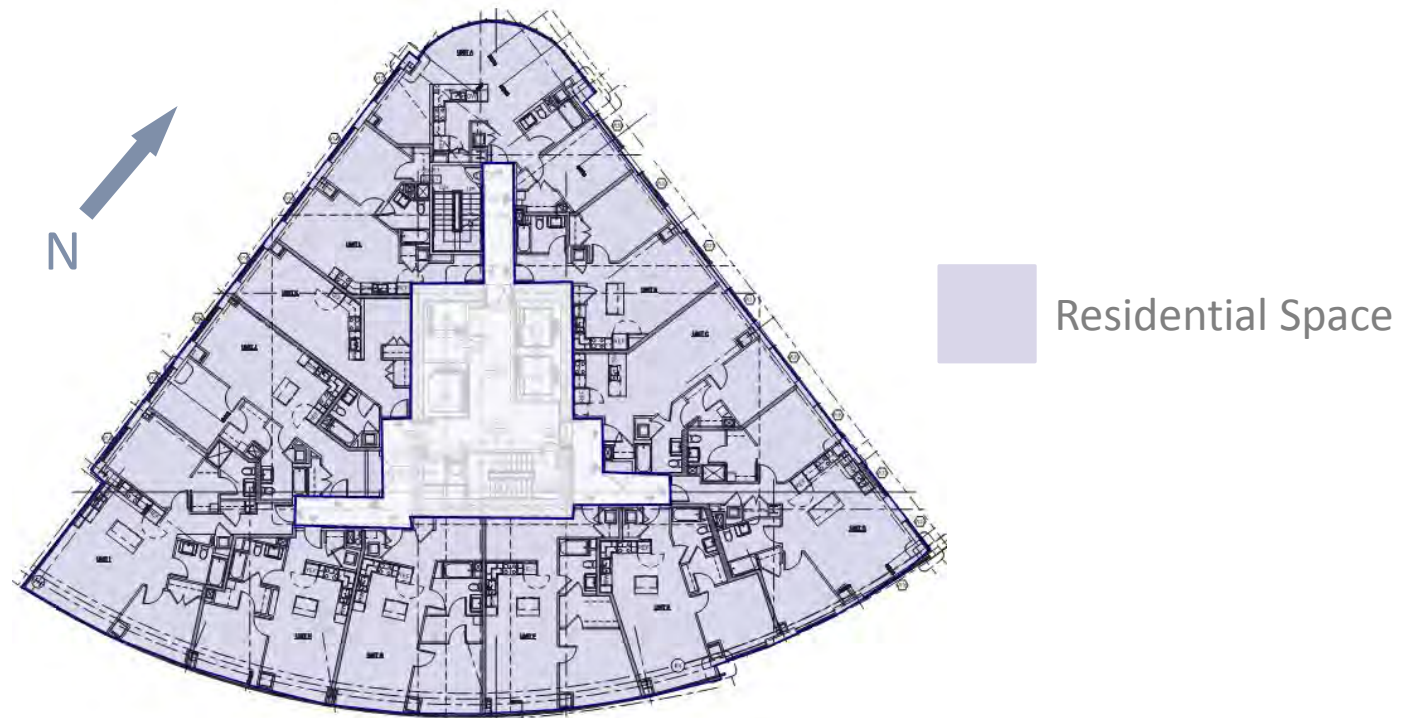


Case Study #3

Radian Boston



- 300,000 ft², 26-story mixed-use residential high-rise



Case Study #3

Radian Boston



Certified LEED Gold

- 32.2% energy savings compared to ASHRAE 90.1-2004
- 25.8% energy cost savings compared to ASHRAE 90.1-2004



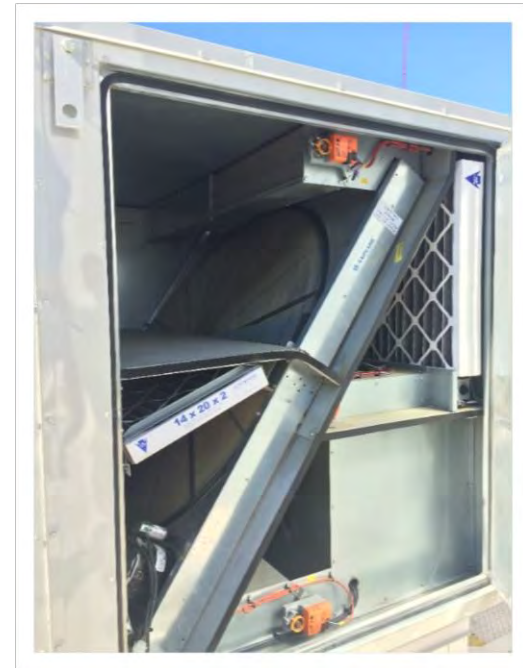
Case Study #3

Radian Boston



Energy Conservation Measures:

- High-performance envelope
- Energy Star appliances
- High-efficiency air distribution
- Energy recovery ventilation
- Condensing boiler plant



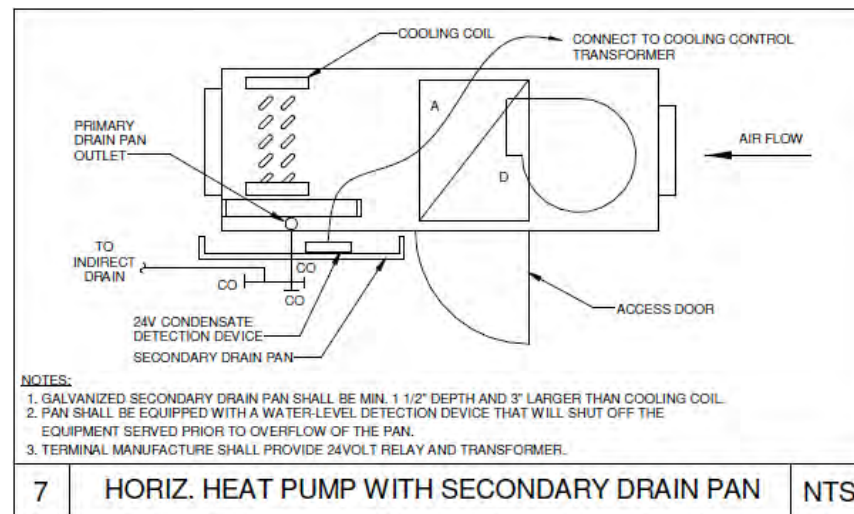
Case Study #3

Radian Boston



Mechanical Highlights:

- Ventilation provided via ERU in combination with operable windows in residences
- Local space conditioning via water-source heat pumps (WSHPs) supplemented by a condensing boiler plant and cooling tower

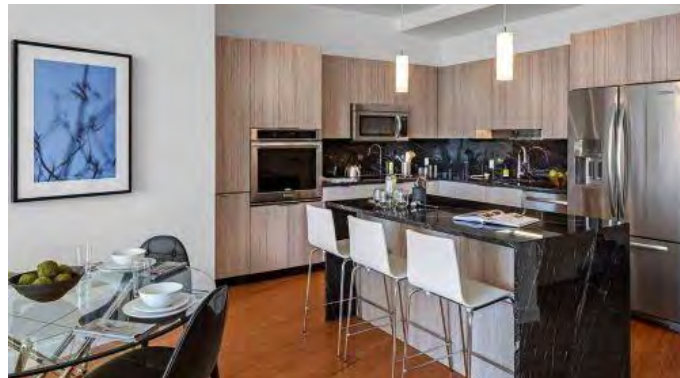


Case Study #3

Radian Boston



- Electrical Highlights:
 - Mixed CFL and LED lighting scheme beat code-maximum lighting power by 10%
 - Energy Star appliances specified in residences allowed credit against plug loads in Baseline energy model.



Case Study #3

Radian Boston

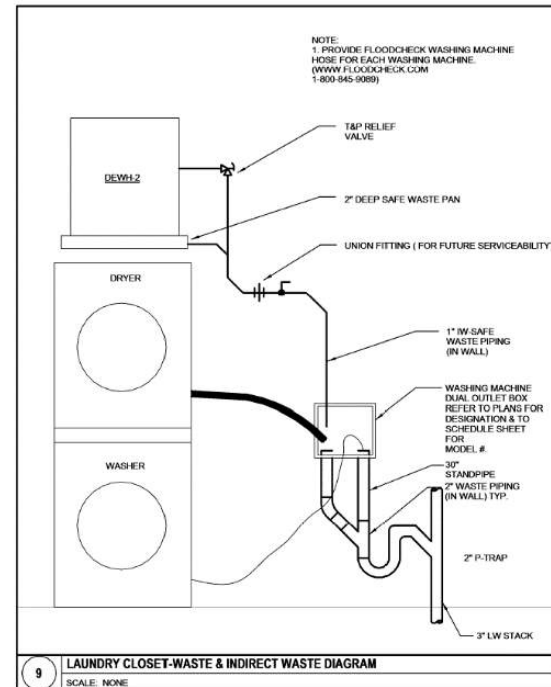


- Plumbing Highlights:
 - Electric water heaters local to each dwelling unit; space constraints within the residences required suspension over washer/dryer setups

Domestic water heater

Clothes dryer

Clothes washer



Case Study #3

Radian Boston



POE Highlights:

- Residence experience: overall thermal comfort, lighting, and layout.
- Maintenance clearance in mechanical penthouse
- Decentralized heating and cooling



Case Study #3

Radian Boston



Issues raised:

- Electric water heater serviceability
- Energy recovery unit controls
- Thermostat placement in studio apartments
- Sound and vibration traveling from mechanical penthouse
- Window frames

Case Study #3

Radian Boston



Lessons learned

- Importance of off-season commissioning
- Necessity of a thorough punchlist
- Impact of value engineering



Foam panel
vibration
isolation inside
the Radian
penthouse.

Agenda

Introduction

What is Post-Occupancy Evaluation?

- Value Proposition
- Process

Case Studies

- Non-Profit: Parks & People
- Science & Technology: Shire Genetics Lab
- Multifamily Residential: Radian

Wrap-Up / Recap

Recap: Value Proposition

Keeps the design team engaged beyond the warranty period.

- 3.5 years after the building was initially occupied, the design team remains engaged in helping the owner.



Recap: Value Proposition

Better understanding of their building and why it was designed a certain way.

- Parks and People: DHW circulation pump

Relatively small (and low-power) pump causes wait for HW in bathrooms but was necessary to achieve project's energy efficiency goals and limit the DHW loop's first cost.

- Radian: DHW heaters

The need to maximize rentable square footage forced the DHW heaters into a tight space.

Recap: Value Proposition

Provides recommendations and corrective actions

- Upgrade lighting from CFL to LED
- Install vibration isolation hangers



Recap: Value Proposition

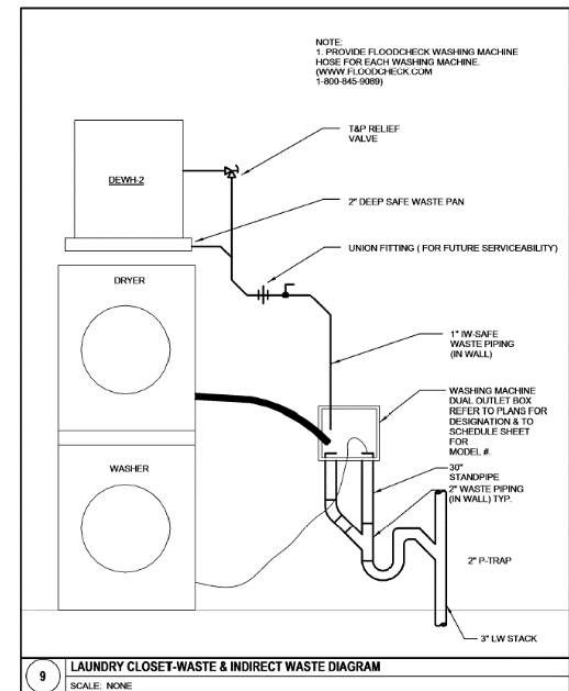
Incorporates lessons learned into future designs

Our plumbing engineers push back on placing equipment in access-challenged spaces.

Domestic water heater

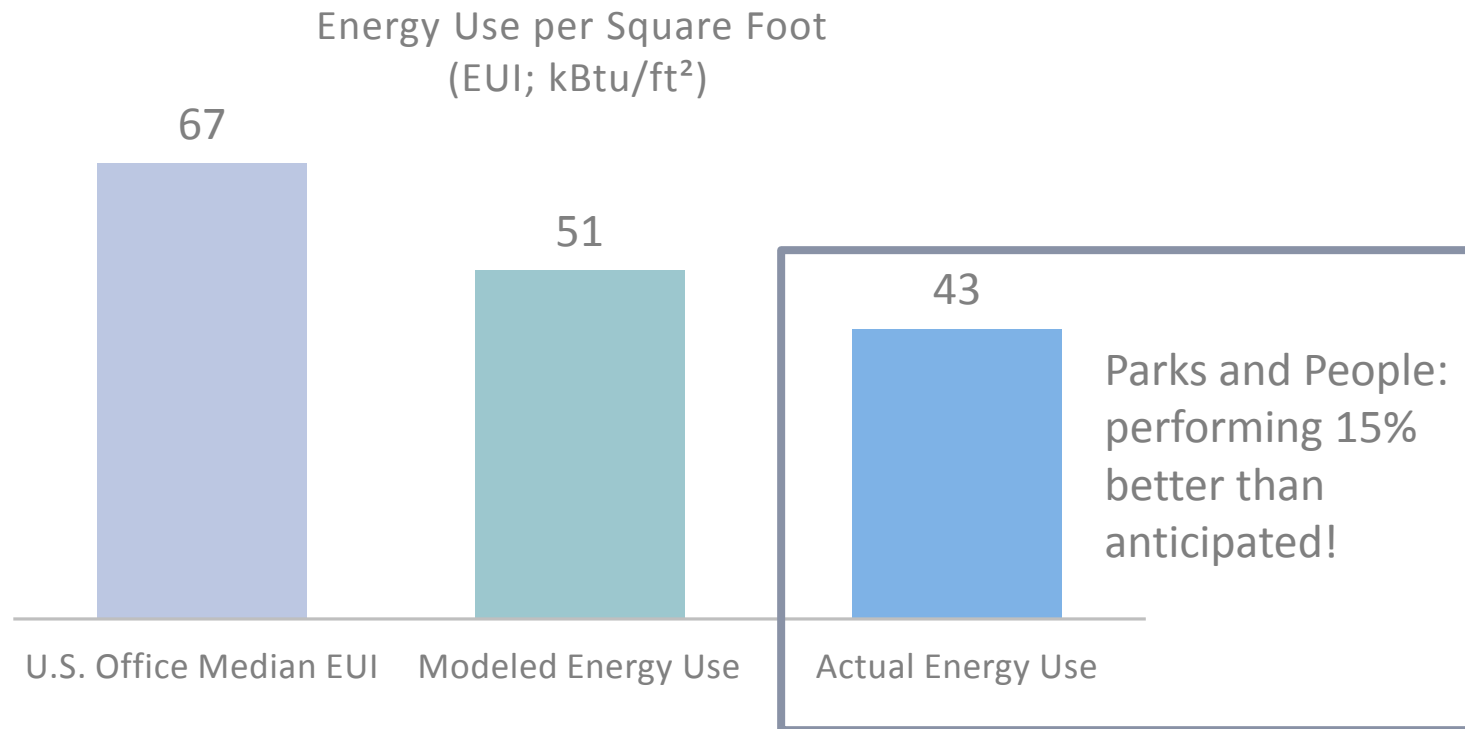
Clothes dryer

Clothes washer



Recap: Value Proposition

- Analyzes real-life performance data to evaluate design decisions
- Follows up on commitments made by the project (EUI, IEQ metrics, etc.)



Recap: Value Proposition

Deepens client relationship

As part of our POE of Parks & People, we were able to engage the architect and the greater Baltimore sustainable design community in a celebration of the project's LEED Platinum achievement.

We continue to work with that client and receive referrals due to this work.



Is POE Worth It?

- **Yes!** Assuming that:
 - The project team desires the data
 - The project team needs to follow up with and impress a good client
 - The project team believes there will be good lessons learned from the project



Questions?

Parks & People
Baltimore, MD



Shire Genetics
Lab
Lexington, MA



Radian Boston
Boston, MA

Mind the Gaps: Post-Occupancy Discoveries from Design to Operation

March 09, 2017
BuildingEnergy Boston

Patrick Murphy: pmurphy@vanderweil.com
Chuck Stellberger: cstellberger@vanderweil.com