U.S. DEPARTMENT OF
ENERGY

Office of
ENERGY EFFICIENCY &
RENEWABLE ENERGY

Commercial Buildings Integration

Building Technologies Office

April 2019

U.S. Commercial Property

6 million buildings

90 billion square feet

20 percent of total energy

U.S. Commercial Property

6 million buildings

103 billion square feet

20 percent of energy used

- Commercial stock: many market sectors, system types and ownership scenarios.

- Approximately 50% of today's commercial building stock was built before 1980.

- Approximately 80% of commercial stock by floor area is privately owned

- Approximately 50 billion SF/50% is leased

Commercial Buildings Integration

Innovate to Optimize

…through original research and development that uncovers holistic, cost-effective approaches to whole building efficiency.

Validate to Understand Performance

… in dynamic, real world environments; create standard methods and datasets to inform R&D.

Cultivate Market Leadership

…to understand technical and structural barriers and identify R&D requirements based on existing market conditions.

Innovate to Optimize (between Building Systems)

"…the systems yielded _additional_ savings of 51-77% "

Comparison of component- vs. systems-based savings for three integrated systems.

| Option	Lighting EUI (kWh/sf/yr)	Lighting Savings relative to Baseline	Lighting Savings relative to Component-based Retrofit
Baseline (Fluorescent, scheduled control)	3.68	–	–
Component-based Retrofit (simple LED)	1.36	63%	–
Automated Shading and Daylighting	0.64	83%	53%
Workstation-Specific and Daylighting	0.31	92%	77%
Task / Ambient and Occupancy	0.67	82%	51%

ISOP Technology Communication Pathways
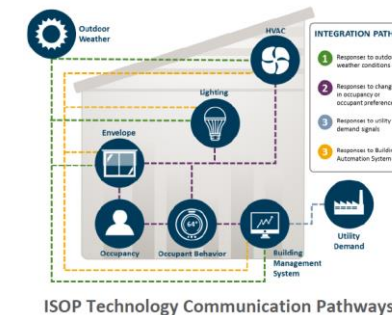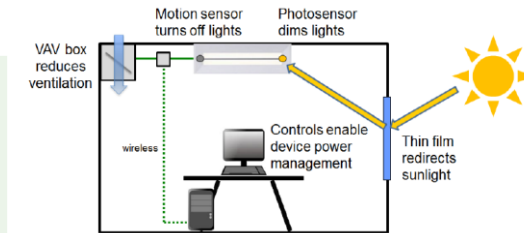
SOURCE: Lawrence Berkeley National Laboratory, _Energy Savings of Systems-Based Building Retrofits: A Study of Three Integrated Systems_. (DRAFT) Cindy Regnier, Paul Mathew, Alastair Robinson, Peter Schwartz, Jordan Shackelford, Travis Walter.

Innovate to Optimize (across Multiple Buildings)
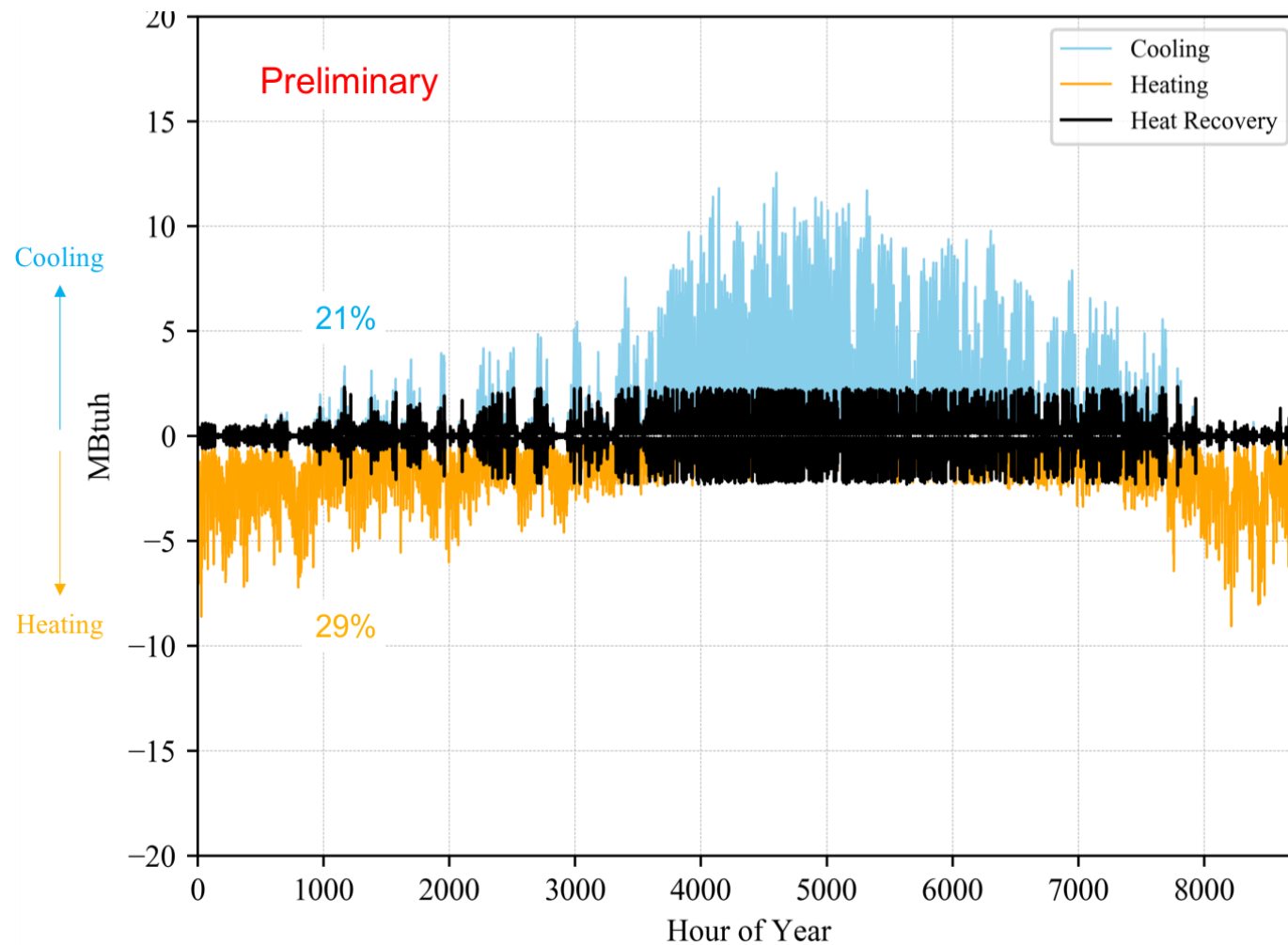
Too much heat in one building; too much cold in another → multiple buildings with infrastructure to share reduce excess and waste.
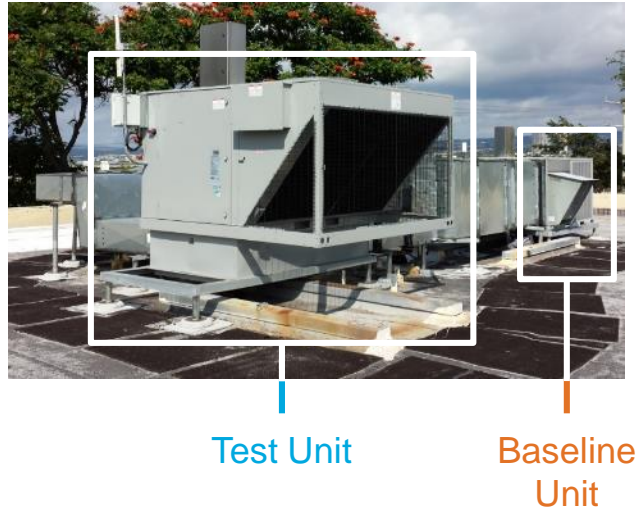
SOURCE: Preliminary ZED Analysis, NREL

Validate to Understand Performance (Field Study)

Working with partners to understand how products perform in real buildings?

Test Unit   Baseline Unit

Reviewed Wednesday and Thursday

- 3rd party, objective evaluation
- real-world conditions: dynamic loads and human interactions

Why?
- Answer critical R&D questions (feedback loop).
- Understand installation, commissioning, operations/maintenance requirements.
- Document interactions with other existing building systems.
- Share energy ad cost savings information with owner/operators.
- Collect, store and share building performance data (utilities, scientists, manufacturers, architects/engineers).

Validate to Understand Performance (Pathway)

Prioritize →	Plan & Develop →	Implement →	Support and Track Market Uptake →	Reduce Energy Consumption →
CBI STRATEGY	**Validation**	**Market stimulation via leading organizations**	**Deployment through leaders' portfolios and consideration for voluntary standards**	**Data feeds into deployment efforts**
ACTIVITIES	Produce a technical **SPECIFICATION** via external engagement including Better Buildings. Conduct **FIELD STUDY** with partners to find host sites and identify metrics for study.	**CAMPAIGN** with market partners to develop and validate solutions, uncover additional barriers and highlight best practices.	Utilities, REOs and OEMs reference technical specs to deploy efficiency levels broadly through voluntary programs and/or certification.	Hand off data and findings to deployment programs (Labs support code analysis and update.)
IMPACTS	Data from the field proves average savings and reduce risk for owners; case studies show the business case	Campaign resources help others by sharing the results of real projects. DOE understands market uptake trajectory, adoption opportunities and challenges.	DOE: - Confirm efficiency levels, cost and savings with market leaders, - Shows sufficient uptake for deployment program consideration.	If widely adopted, the ISOP package can save **765 TBtu/yr in energy and reduce energy costs for businesses by $25.5M.**

Validate to Understand Performance (Methods & Data)

Reviewed Monday

A common language and framework for defining, collecting, storing and sharing building performance data.

Data Element	Definition	Required (R)/ Preferred (P)*	Data Type	Unit	Additional Notes
id-point	Unique identifier for the measurement point	R	Alphanumeric		
siteRef	Reference to the id of the site where this measurement was taken	R	Alphanumeric		
equipRef	Reference to the id of the equipment for which the measurement was taken	R	Alphanumeric		
outside-temp	The measured outside air temperature	R	Numeric	◦F	
supply-temp	The measured supply air temperature	R	Numeric	◦F	
sp-temp-cooling	The setpoint temperature for cooling	R/P	Numeric	◦F	Required for systems integrated with the BMS; preferred for slave ARC.
sp-temp-heating	The setpoint temperature for heating	R/P	Numeric	◦F	Required for systems integrated with the BMS; preferred for slave ARC.
power-fan	The VFD-reported supply fan power demand or the average power over an interval	R/P	Numeric	kW	Required for all systems with a variable- or multi-speed supply fan.
energy-elec-fan	The VFD-reported supply fan electricity consumption over an interval	R/P	Numeric	kWh	Required for all systems with a variable- or multi-speed supply fan.
power	The estimated power demand or the average power over an interval for the entire unit	R	Numeric	kW	This can be estimated using an amperage meter.
energy-elec	The estimated electricity consumption over an interval for the entire unit	R	Numeric	kWh	
	The estimated gas consumption				Required for systems

Validate to Understand Performance (Whole Buildings/ZE)

2018 ENERGY EFFICIENCY INDICATOR SURVEY
UNITED STATES

For more information on the study, please visit www.johnsoncontrols.com

UNITED STATES		GLOBAL

NET ZERO ENERGY/ CARBON

61% ⬆ 14% y-o-y

Indicated that it is an extremely or very important factor when considering future energy and building infrastructure investments.

50%

19 mayors pledge to make all new buildings net-zero by 2030

By 2050, all buildings, old or new, will be required to generate more power than they use

By Alissa Walker | @awalkerinLA | Aug 23, 2018, 6:24pm EDT

Get a glimpse Wednesday

ZERO CODE: THE FUTURE HAS ARRIVED

April 2018 | Announcements | Initiatives

ZERO CODE™

Introducing the first national *and* international ZERO Code standard for new commercial, institutional, and mid- to high-rise residential buildings.

FACILITY EXECUTIVE
Creating Intelligent Buildings

Turf — The MOWING ISSUE

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Aiming For Zero Energy In Existing Buildings

Facility management is on the front line of an expanding vision for the built environment.

October 9, 2018

By Alexi Miller

From the October 2018 Issue

Industry

Going all in: USGBC creates net zero certification

NET ZERO CERTIFICATION

Cultivate Market Leadership (Owners/Operators)

The Better Buildings Challenge

- 20% savings over 10 years
- 380 Tbtus and $3.1 billion saved (as of 2018)
- 4.4 billion square feet

The Better Buildings Alliance

- 230+ Partners
- 11 billion square feet of real estate (13% of commercial buildings)
- 7 active Tech Teams
- 3 technology campaigns
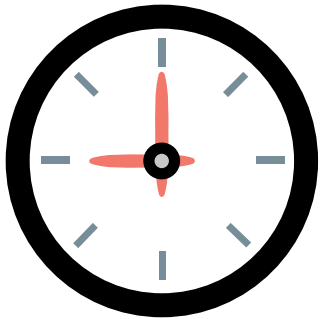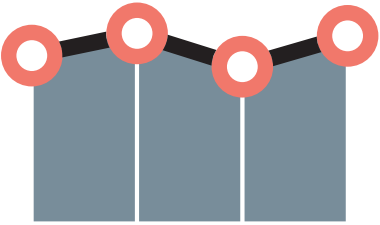
The Better Buildings Accelerators

- Thought leaders share best practices
- 9 active Accelerators helping breakdown barriers, create tools and resources for other businesses to use.

Reviewed Wednesday

Cultivate Market Leadership (with Utilities)

1. Innovation in pilot projects to support the most impactful EE (and DR) programs (Prescriptive-like Packages)

2. Data standardization for performance-based program design and evaluation (M&V 2.0, BEDES, BuildingSync, unstructured data)

3. Field verification methodology for emerging technologies (Tech2Utilities, GPG, AFDD & EMIS Protocols)

4. Continuous development and evaluation tools (Beyond Widgets, NREL Commercial Test Bed)

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