Better Buildings®
U.S. DEPARTMENT OF ENERGY

Smart Labs Accelerator Partner Meet-Up

May 15, 2017

1:30-5 p.m.

U.S. DEPARTMENT OF ENERGY

Accelerator Milestones

- Establish a 10-year target of at least 20% energy reduction across lab portfolio, with a near-term 5% savings at one lab
- Create detailed road map to achieving 20% target
- Develop a metering plan, baseline and metrics to measure lab energy performance
- Participate in peer exchanges and share solutions

Energy Targets

Establish a 10-year target of at least 20% energy reduction across lab portfolio, with a near-term 5% savings at one lab

- 10-year target is largely aspirational
- Near-term target should be met before end of Accelerator through no- and low-cost measures
- Share with DOE data demonstrating 5% reduction and details on measures taken, to be documented as case studies
  (more discussion later)

Partner Roadmaps

Develop a detailed road map to achieving the 20% target

- I2SL to provide general roadmap in 2017
- Partners will work off the general roadmap to create their own customized roadmaps, with drafts due by end of year two. DOE/I2SL provide feedback on this draft with a final roadmap due from partners at end of year three
- Implement at least one capital investment project and/or establish a strategic energy management (SEM) plan
  - DOE can help with SEM, leveraging new on-line tools informed by the ISO 50001 energy management standard

Metering and Reporting

Collaborate with DOE/partners to develop metering and energy performance measurement approaches

- By the end of year one develop a metering plan, establish a baseline, identify key metrics that measure lab energy performance
- Report performance data to demonstrate progress toward 5% savings target by the end of the Accelerator period

Peer Exchange/Solution Sharing

- Participate in peer exchanges to discuss barriers and solutions.
- Meeting frequency? Quarterly? Individual or all partners with I2SL and DOE?
- Working groups?
- Posting of Partner information?

Get Involved

Getting Started

Contact:

Otto VanGeet
Otto.vangeet@nrel.gov
National Renewable Energy Laboratory

I^2SL Chapters (Members)
http://i2sl.org/globalcommunity/chapters.html
http://projects.erg.com/conferences/i2sl/members/members.asp

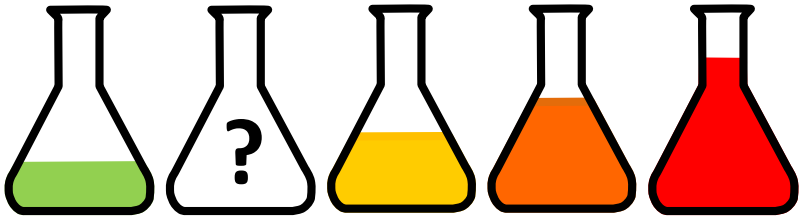
Phil Wirdzek
President and Executive Director
I^2SL
540.843.2005
or
info@i2sl.org

I2sl Lab Benchmarking Tool

U.S. DEPARTMENT OF ENERGY

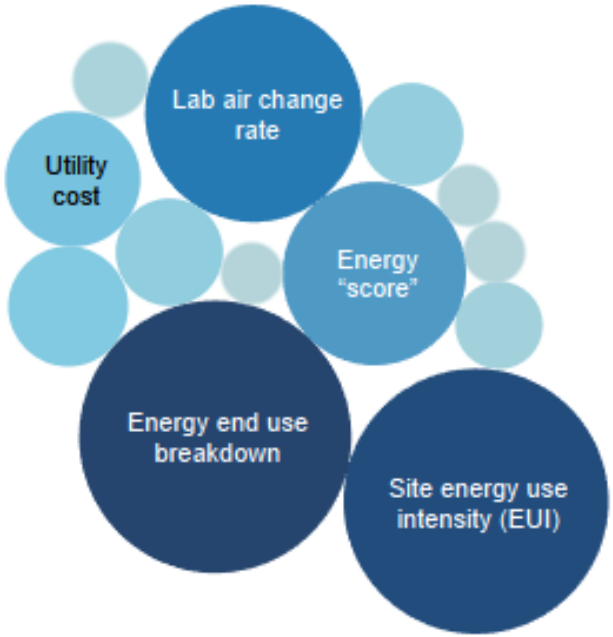
The Lab Benchmarking Tool

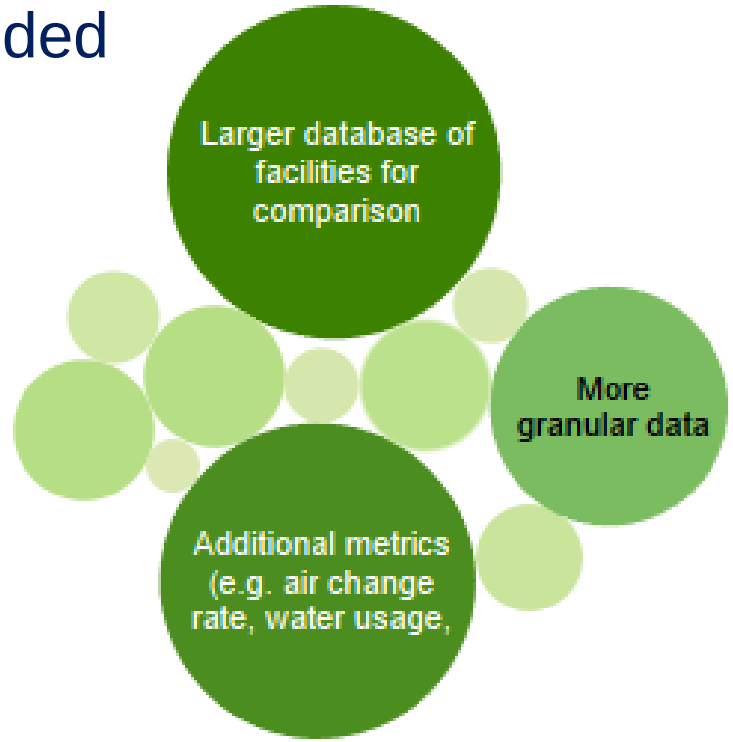
- A new, enhanced benchmarking tool for lab buildings
- Replaces the venerable Labs21 Benchmarking Tool
- Continues long-term collaboration between I^2SL and LBNL
- The new Lab Benchmarking Tool will:
  - Retain access to the unsurpassed Labs21 dataset, crowdsourced over past 15 years: 639 buildings, 120 million sf (5% of US total)
  - Provide a completely new user interface with new graphing capabilities
  - Contain expanded data fields, additional building assessment metrics, case studies, and improved data quality control



Driven by Market Research

- I^2SL surveyed nearly 400 industry professionals in 2015
- Benchmarking important or **very important** to 80% of respondents
- Much enthusiasm for expanded database and new metrics

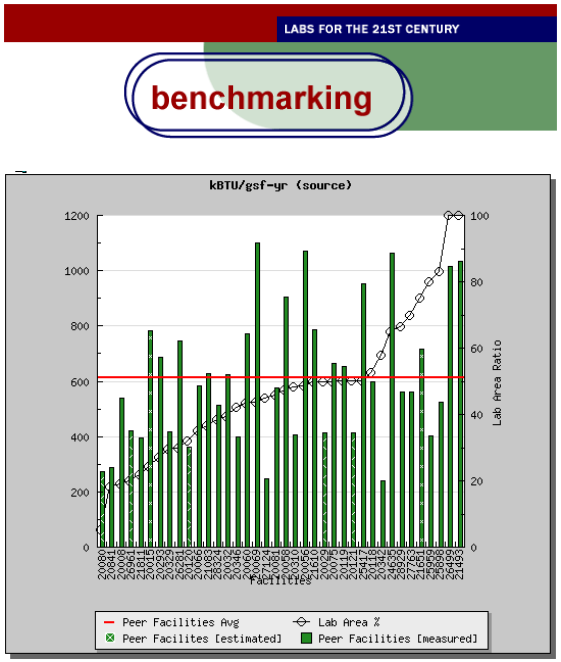




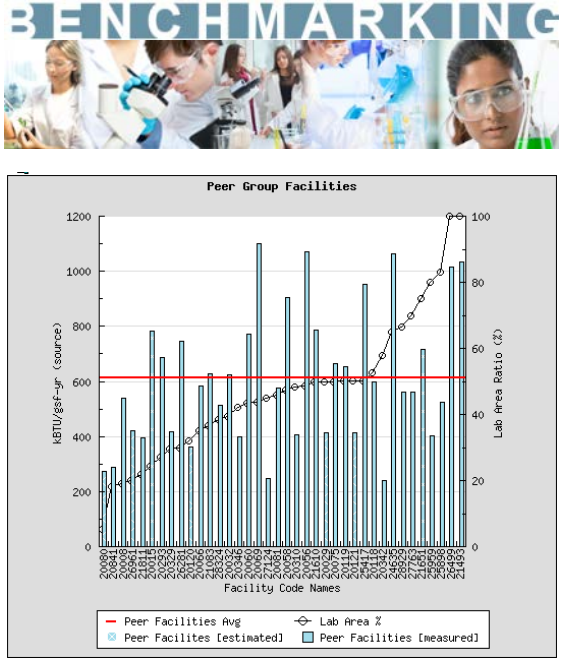
New User Interface

- I²SL and LBNL gave the old tool a facelift last year
- The new tool will have a **completely new** interface and modern, advanced graphing so users can fully explore the data

2002



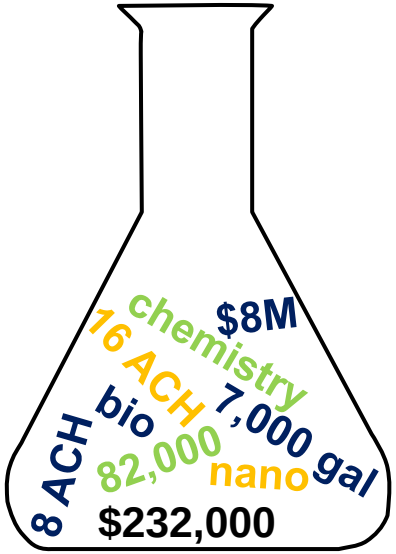
2016



2018

COMING SOON

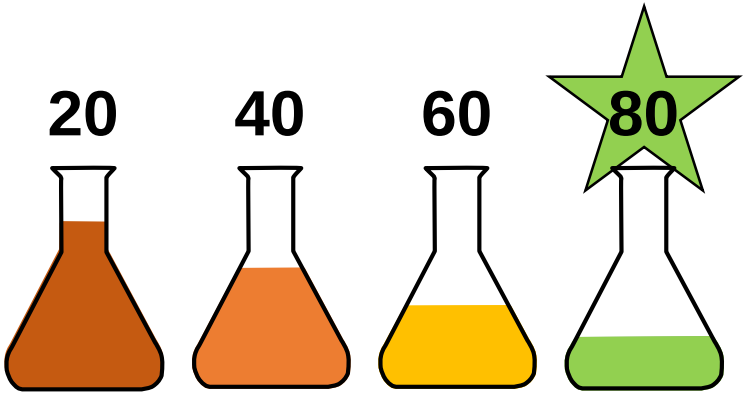
Expanded Data Fields



- **Modernized, more granular** functional requirements:
  - Modern lab building types, e.g. integrated science centers, biotech incubators, nanotechnology labs
  - Ventilation rates/hazard classifications
  - Process loads
- New featured **metrics** for building comparison:
  - Water usage
  - Energy cost
  - Energy score (see next slide)
- Improved data QC
- Additional resources to improve **actionability**:
  - System-level benchmarking references
  - Accelerator partner case studies
  - I^2SL best practice guides

An Energy Score for Labs

- Explore development of a rating system for labs
- Use highest quality data from database
- Regression analysis based on lab-specific functional requirements
- Akin to an ENERGY STAR score
- Easier to gauge and track a building's performance



O&M Training

U.S. DEPARTMENT OF ENERGY

Training for Laboratory Facilities

Managing and Maintaining Smart Labs

Thomas C. Smith

ECT, Inc.

Exposure Control Technologies, Inc.
919-319-4290
tcsmith@labhoodpro.com

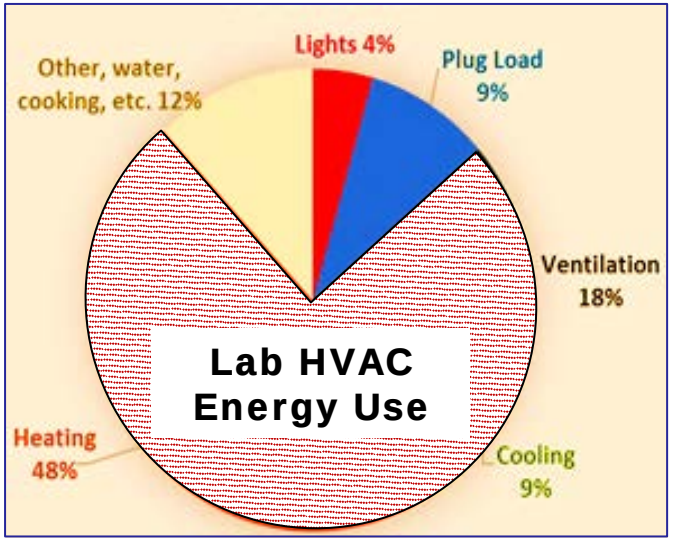
Laboratories and Critical Control Environments

- Government
- Universities
- Chemical
- Biotechnology
- Pharmaceutical
- Industry

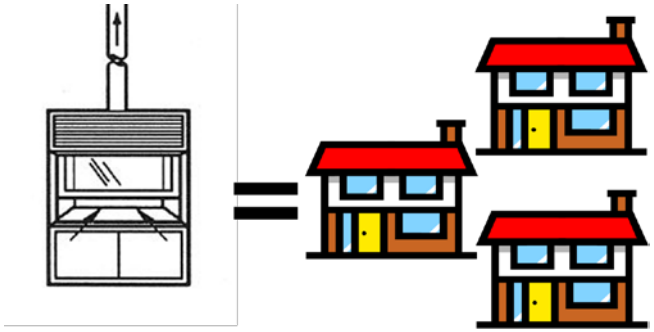
- 17,000 Laboratory Facilities in the United States (LBNL 2016)
- Expensive to build and operate (e.g. high energy consumption)
- Complex and challenging to manage and maintain
- Wide spectrum of risk and potential for liability

Laboratories – Expensive, Complex, Challenging

- Average Lab Size ≈ 100,000 ft^2
- Construction$_{(USA)}$ ≈ $45 Million to $100 Million
- Special Life Safety Systems = High Cost
- Energy Cost ≈ $700,000 / year (Avg. $7 per ft^2)
- Labs consume 7 - 10 times more energy than administrative/commercial office buildings

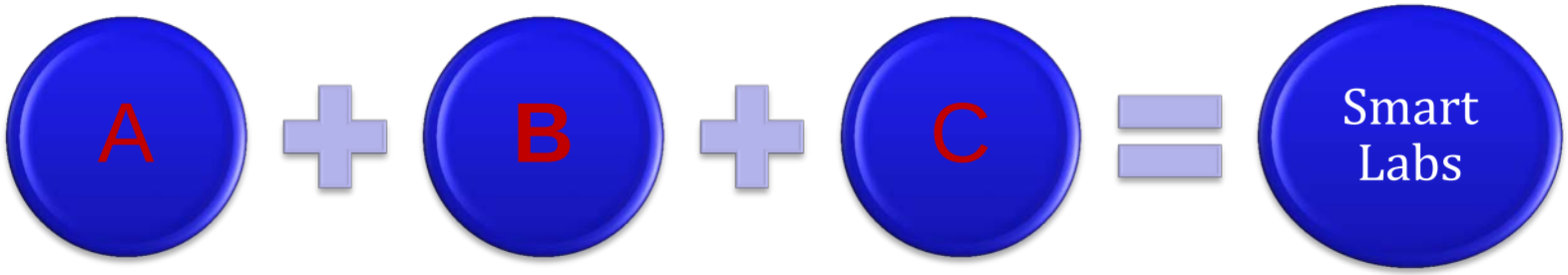


- Lab HVAC and Fume Hoods ≈ 15% to 30% of Construction Cost
- Lab HVAC and Fume Hoods ≈ 45% to 85% of Energy Use
- Fume Hood Installation ≈ $25,000 - $50,000 each
- Fume Hood Annual Cost ≈ $2,400 – $5,000 per year



Fundamental flaw jeopardizes safety and wastes 40% of energy

The A, B, C's of Smart Labs™



A = Safe

What are the appropriate exposure control devices and minimum operating specifications required for safety?

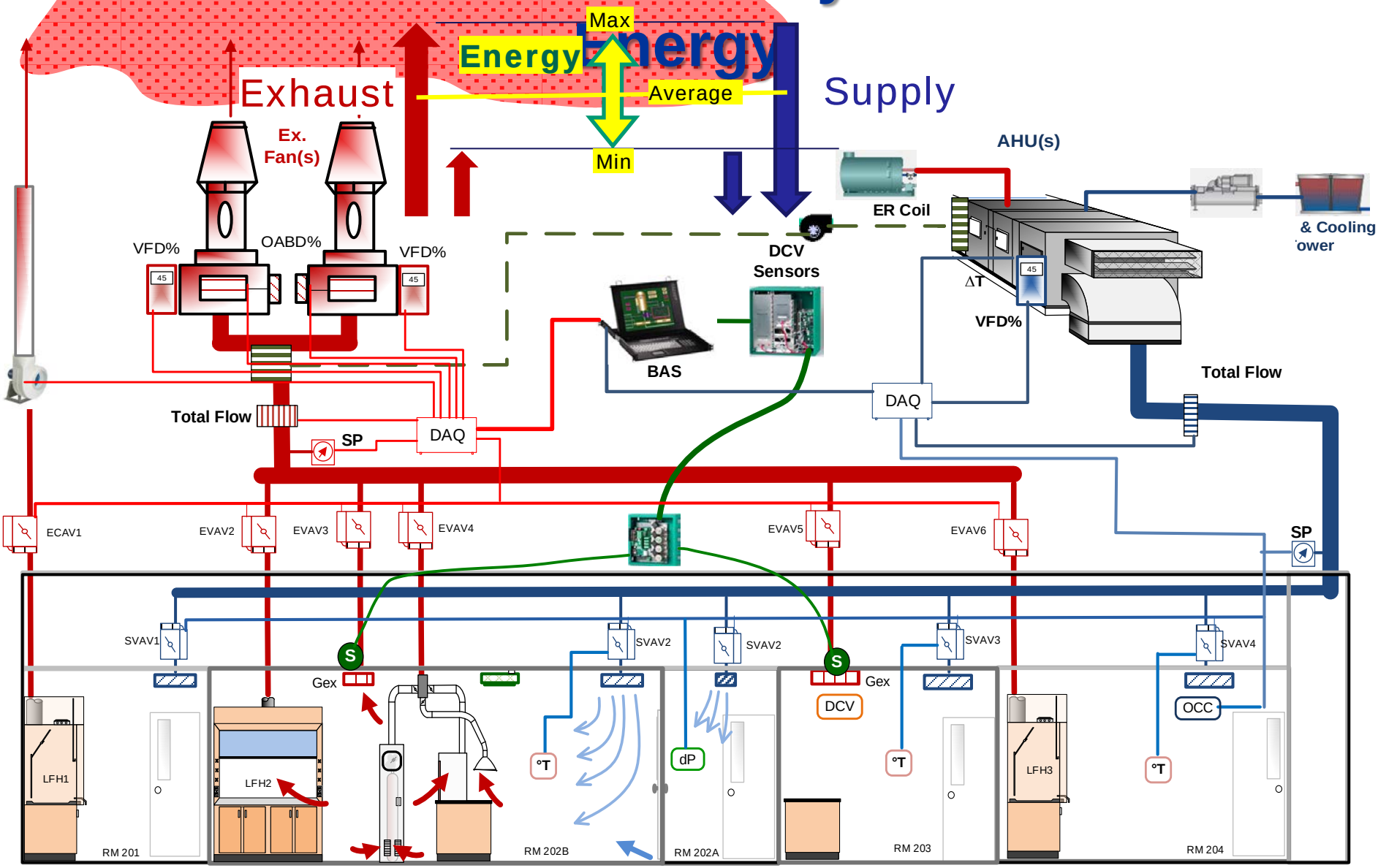
B = Efficient

How do we operate the systems efficiently at the lowest possible flow and energy use?

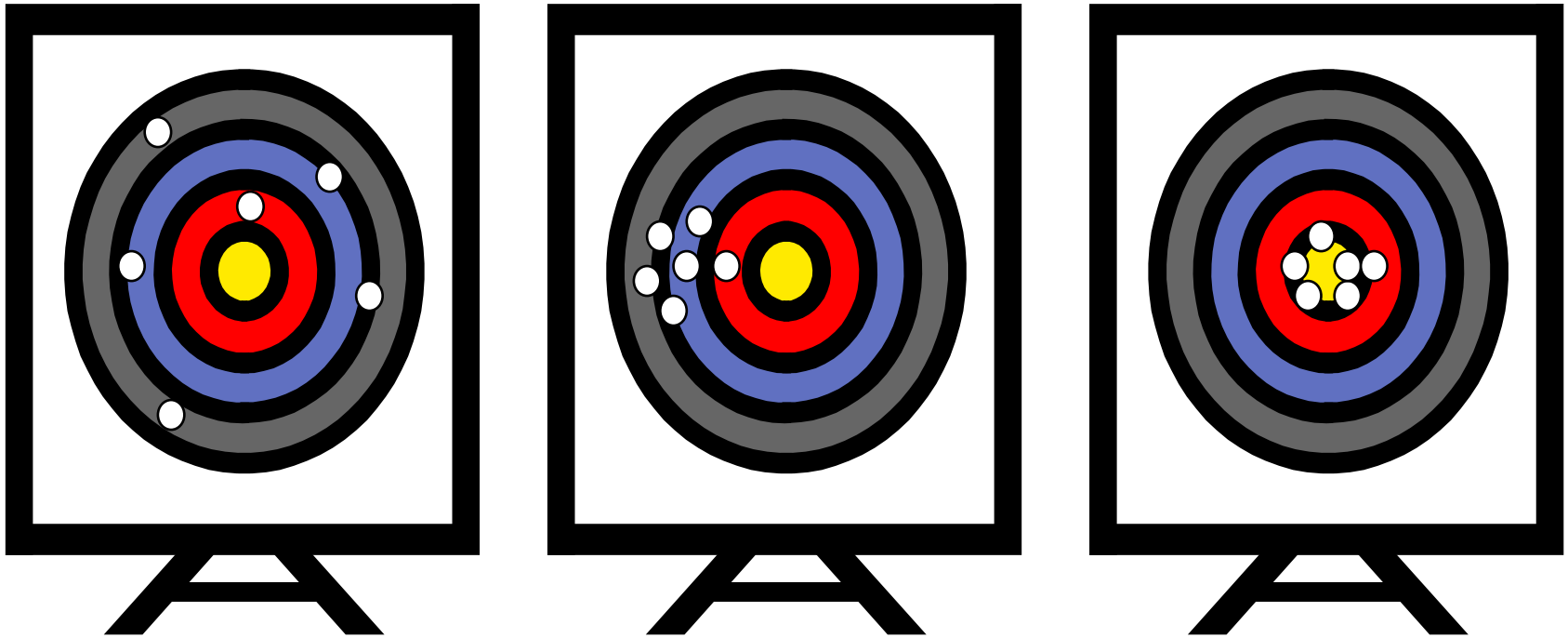
C = Sustainable

What must be done to maintain efficient and effective operation for the life cycle of the systems?

Smart Labs Ventilation System – Flow & Energy



Quality Data - Accuracy and Precision



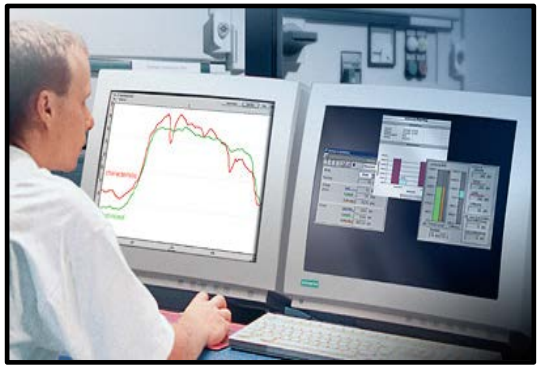
VAV Systems <u>Can</u> degrade

30-50% within 5 years

Lab Ventilation Management Program (LVMP)

- **Stakeholder Coordination**
  - Roles and Responsibilities
  - Collaboration and Communication
- **Ventilation Risk Assessment**
- **ECD Selection and Design**
- **Ventilation System Design**
- **Performance Validation**
- **Maintenance and Routine Tests**
- **Management of Change**
- **Personnel Training**

Training of Personnel



- Lab Personnel
- Facility Maintenance
- Building Operators

Smart Labs Stakeholders and Levels of Training

I

- Senior Management and Directors Facility Engineering, EH&S, Sustainability, Maintenance

II

- Building Managers, EH&S Personnel, Supervisors, O&M Personnel

III

- Qualified Smart Labs Specialists

Training Modules for Smart Labs High Performance Ventilation Systems

I

- Leading Implementation of a Smart Labs Management Program

II

- Managing Smart Labs High Performance Ventilation Systems

III

- Smart Labs High Performance Ventilation Specialist

Training for High Performance Lab Ventilation Systems

- **Module 1: Leading a Smart Labs Management Program (1 day)**
  - Part 1. Organizational Benefits, Leadership Requirements and Costs (2 hr.)
  - Part 2. Performance Goals, Resource Allocation and Program Management (6 hr.)
- **Module 2: Managing Smart Labs (2 day)**
  - Part 1 - Stakeholder Coordination, Roles and Responsibilities
  - Part 2 - Design, Operation and Management of Change
  - Tasks, Schedules and Deliverables
  - Proficiency Exam to Qualify Personnel for Proceeding to Module 3
- **Module 3: Smart Labs Specialist (7 days Intense Hands On Training)**
  - Part 1. Laboratory Ventilation Performance, Testing and Maintenance (3 days)
  - Part 2. Lab Ventilation Controls and Building Automation (2 day)
  - Part 3. Mechanical Systems Operation and Maintenance (2 day)
  - Competency Exam for and Certification

BETR Grants

U.S. DEPARTMENT OF ENERGY

Bringing Efficiency to Research Grants (BETR Grants)

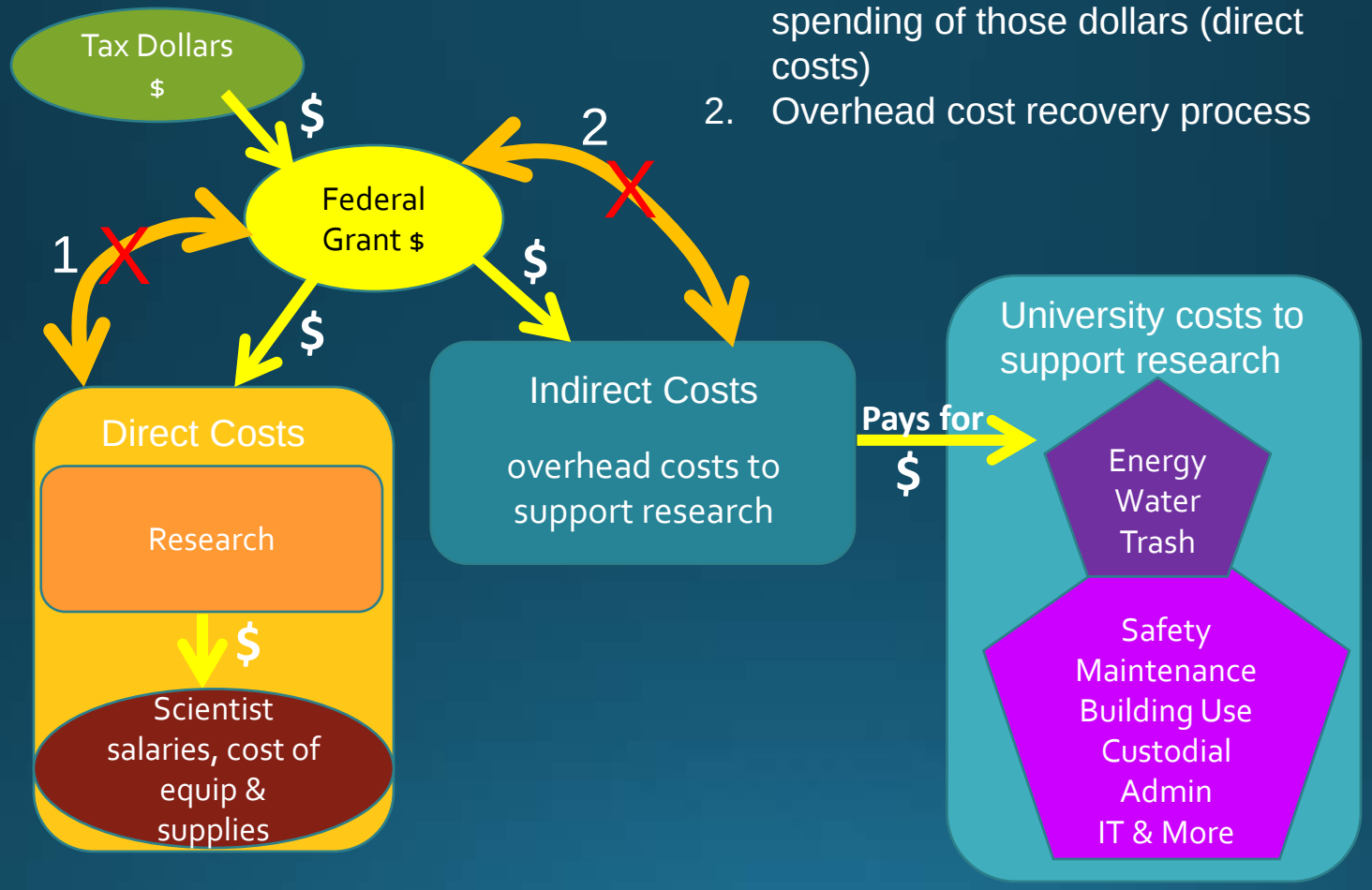
Kathy Ramirez-Aguilar, Ph.D.
I²SL University Alliance Group Chair
Green Labs Program Manager, University of Colorado Boulder

Greening Federal Grants = BETR Grants

Previous Name | Current Name

Missing Efficiency Connections in Federal Funding of Research at Universities

1. Federal granting process & spending of those dollars (direct costs)
2. Overhead cost recovery process



Scientists facing rising competition for federal funding

Small or lack of increases in federal research funding

+

More university scientists competing for federal funding

+

Inflation decreasing buying power of federal funding

=

Rising competition for federal funding

Bringing Efficiency to Research Grants (BETR Grants) is about connecting efficiency with federal research funding

Efficient use of resources:

- Maximize effective use of federal research funding
- Minimize the environmental footprint of research

BETR Grants: Are there connections to federal funding that can greatly improve?:

Equipment Sharing

Space Efficiency

Selection of Energy/Water/Material Efficient Processes & Equipment

IT resource sharing

BETR Grants is a win-win. It is in everyone's best interest.

1. Scientist → more money for research & easier access to equipment resources
2. Tax-payer & government → better use of federal dollars
3. University → benefit sustainability commitments & financial savings since federal overhead $$ do not cover all costs
4. Environment → reduced research footprint

Visit new BETR Grants website: www.i2sl.org/betrgrants

- Website is resource on how to include efficiency in grant proposals
- UC Santa Barbara - already taking action
- NSF “Broader Impacts” section could include how efficiency in labs contributes to broader campus sustainability goals
- Feedback received – it’s a good idea!
- Early adopters will be seen as leaders

Plans going forward

- Grow and enhance BETR Grants website
- Campaign to encourage universities to voluntarily incorporate actions for efficiency in grant proposals
- Monthly informal phone calls- email me to sign up
- Presentations- DOE Summit (Tues. 5/16, 2:15PM Columbia), I^2SL, NIH
- Outreach and collaboration with federal agencies

QUESTIONS?

Contact Information:

Kathy Ramirez-Aguilar, Ph.D.
kramirez@colorado.edu

I2SL SLAMM

U.S. DEPARTMENT OF ENERGY

Continuous Improvement Tool: *Commissioning the People*

Project Lead: Allen Doyle

Jim Coogan, Siemens; Quentin Gilly, Harvard; Suzanne Belmont, NREL

+ ~20 Content Developers

apdoyle@ucdavis.edu

Staffing and Systems = "Stakeholders"

- Facilities
- Automation/BAS
- Safety
- Researchers
- Building Design
- Capital Planning

May work in silos

Upgrades are Complex:

- Technology
- Finances
- Stakeholders

Upgrades are Complex:

- ✓Technology
- ✓Finances
- ? Stakeholders

A lagging stakeholder may hold up an upgrade when technology and finances are available

Continuous Improvement = “Maturity Model” STAGES

5 Optimizing

4 Integrated

3 Standardized

2 Managed

1 Individual

Benchmarking Matrix

	MATURITY MATRIX					
	Facilities	BAS	EHS	Lab Workers	Building Design	Capital Planning
Maturity						
Stage						
5 Optimizing						
4 Integrated						
3 Standardized						
2 Managed						
1 Individual						

Detailed Content in Each Cell

	MATURITY MATRIX					
	Facilities	BAS	EHS	Lab Workers	Building Design	Capital Planning
Maturity						
Stage						
5 Optimizing						
4 Integrated						
3 Standardized						
2 Managed						
1 Individual						

1) Face Velocity ±5%
2) Hood Hibernation SOP
3) Controls visible in field

Detailed Content in Each Cell

MATURITY MATRIX

	Facilities	BAS	EHS	Lab Workers	Building Design	Capital Planning
Maturity						
Stage						
5 Optimizing	Freezers located in hallways/alcoves - space not designed for ULT Freezers	Individual researchers with some of ULT freezers that are connected to an alarm notificaiton monitoring temperature	No published disposal guidelines	No sample management, no filter or coil cleaning,	HVAC undersized, no air management	No procurement standards; Take ULT inventory by counting or through Materiel Management office > $2,000 items
4 Integrated	Freezers hooked up to emergency backup	Individual researcher with ULT freezers connect to alarm notification monitoring current and temperature	Biohazard and Hazardous waste guidelines published	Some Sample Management and Consolidation, Maintains Freezer filters and coils	HVAC oversized, no air management	Established list of energy and space efficient ULT freezers that have been measured through a 3rd party
3 Standardized	Freezers are connected to emergency liquid nitrogen backup	>25 % of ULT freezers are alarmed centrally;	Central Collection points for Biohazards	Using RTSS for Shipping; > 25% of inventory in database	Good Air Management - Supply Air introduced in the front and Exhaust Air is pulled from the rear (hot & cold aisles)	Centralized strategy of targeted models
2 Managed	Centralized Freezer Farms for Archival Storage of Samples	>50% alarmed centralized; 5% monitored for current and temperature with central administrator	Organized regular collection events	Utilizing Room Temperature Storage for > 5% of samples; > 50% of inventory in database	Air economizing, water cooling considered	Phased replacement of ULT freezer reaching end of life
1 Individual	Centralized Freezer Farm designed with good air management, and support staff to respond to freezer failures, maintain freezers, and manage samples	>90% ULT freezers connected to an alarm notification or monitoring current and temperature	Disposal assistance available	> 75% of inventory in database	Utilizing reject heat	Purchase of alternative ULT freezers such as water cooled, liquid nitrogen, and Stirling Engine

Role of Stakeholders

	MATURITY MATRIX					
	Facilities	BAS	EHS	Lab Workers	Building Design	Capital Planning
Maturity						
Stage						
5 Optimizing						
4 Integrated	X					
3 Standardized		X	X		X	X
2 Managed				X		
1 Individual						

Not Reaching Goals Can Motivate New Resources

	MATURITY MATRIX					
	Facilities	BAS	EHS	Lab Workers	Building Design	Capital Planning
Maturity						
Stage						
5 Optimizing	G	G			G	
4 Integrated	X		G			G
3 Standardized		X	X	G	X	X
2 Managed				X		
1 Individual						

Chart Area

(Ctrl)

Possible Initiatives

- Fume Hoods
- Ventilation Management
- Cold Storage
- Plug Load
- Metering
- Water
- Waste Reduction
- Engagement
- Procurement

First Initiative

Fume Hoods

Ventilation Management

Cold Storage

Plug Load

Metering

Water

Waste Reduction

Engagement

Procurement

Next Steps
Smart Lab Accelerator Maturity Matrix (SLAMM)

Develop Platform 2019

- On-line, Multiple Inputs
- Confidential
- Motivating Output
- Trackable

Tune up Content 2017-18

Develop Benchmarking Process

Carnegie Melon CMMI

Capability Maturity Model, On-Line

TOPICS: Software Development, Management, process, retail, risk, infrastructure, procurement

Voluntary Adoption vs.

- Required Level, 3rd Party Certification

UC Irvine Smart Labs™ Initiative

U.S. DEPARTMENT OF ENERGY

UC Irvine Smart Labs™ Initiative: What We've Learned

Wendell Brase
Associate Chancellor for Sustainability

Matt Gudorf
Assistant Director Energy, Engineering, and Inspection

Better Buildings CHALLENGE
U.S. DEPARTMENT OF ENERGY

UCI University of California, Irvine

What We *Suspected* in 2008

- Buildings had waste designed-in – and not just a few percent!
- Entrenched professional culture of overdesign and tolerated energy waste, dressed up as “margin of safety” and “best practices”
- Beliefs about how much energy savings might be feasible were possibly low
- Concept of “smart” buildings was oversold, underdeveloped

Why 50% Savings *Might* Be Possible

- Buildings' energy systems were designed to waste more energy
  than we realized
  - "Energy is almost free"
  - Over-design justified by a "margin of safety"
  - Building systems were not really "smart"
- Older, non-dynamic systems operated at fixed volumes/levels/speeds and "worst case" parameters
- Prior to digital controls and sensors, a "margin of safety" *was* needed
- Energy to pump water and air is non-linear
- Re-heat is excessive when air changes are high
- Building systems design practices have enormous momentum!

“Smart” Buildings

Just enough energy,

at just the right place,

at just the right time!

“Smart” Buildings

Just enough energy, at just the right place, at just the right time!

How:

- ✓ Challenge all accepted design practices
- ✓ Use software and sensors to make building systems dynamic and “smart”

“Smart” Buildings

Just enough energy, at just the right place, at just the right time!

How:

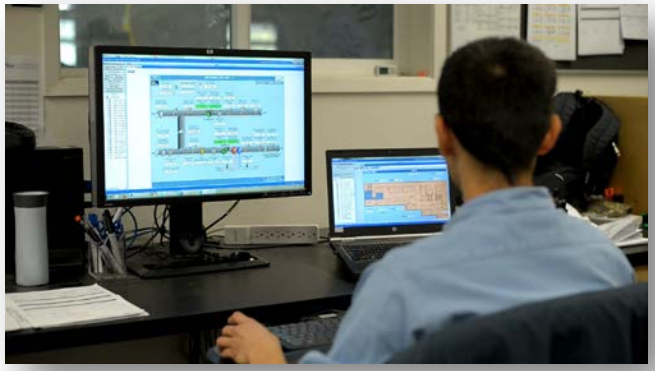
- ✓ Challenge all accepted design practices
- ✓ Use software and sensors to make building systems dynamic and “smart”

Would whole-building retrofits enable energy savings >50%?

1. Fundamental platform of dynamic, digital control systems
2. Demand-based ventilation
3. Low power density, demand based lighting
4. Exhaust fan discharge velocity optimization
5. Pressure drop optimization
6. Fume hood flow optimization
7. Commissioning with automated cross platform fault detection

What We Learned in 2009-10

- What we'd suspected in 2008 was confirmed – and then some!
- Sensors and software changed everything!
- Pilot first, then scale-out
- "Information layer" as important as dynamic building control systems, themselves



Continuous Commissioning (SkySpark)

-- Meaningful analysis and reports
-- Actionable information
-- Verification of actions taken:

CDCV

- Find failed lab air control valves
- Review of fume hood sash management
- Ensure safe lab air quality

flows due to point sources of heat

Submeter ing

- Monitoring of fans, pumps, and lighting control systems
- Verification of energy retrofits
- Reduce

operations

BMS

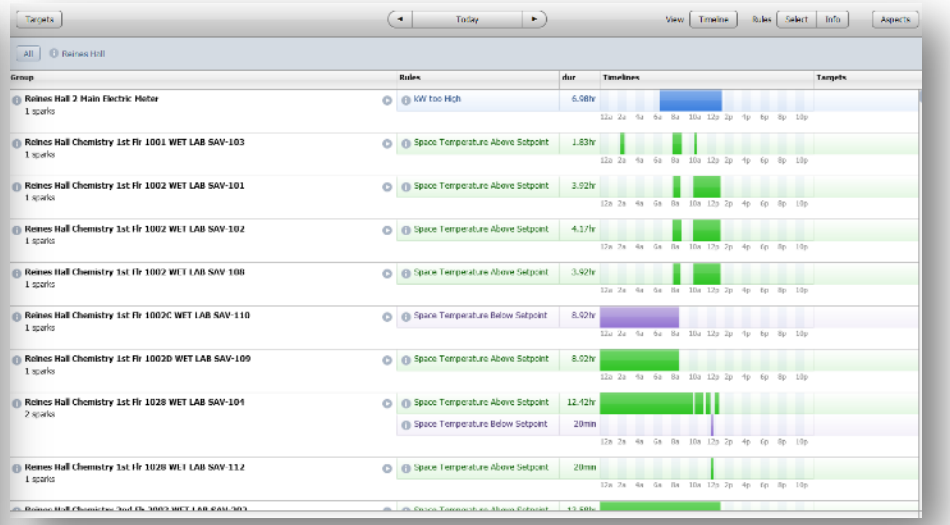
- Locate simultaneous heating and cooling
- Reset of static pressure to minimum required
- Control run

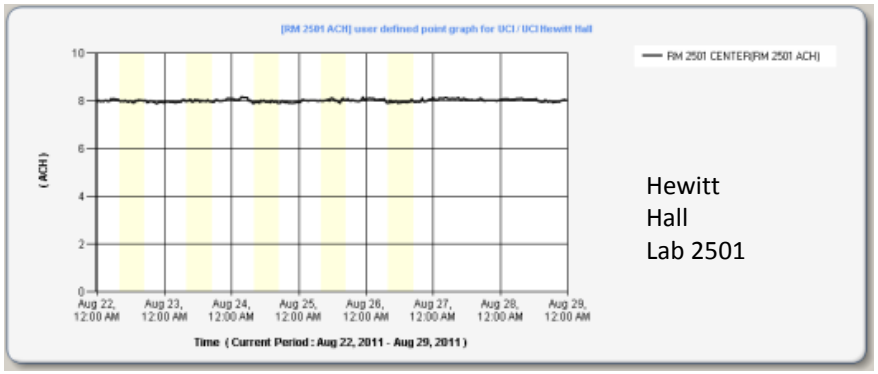
Lighting

- Lighting failures
- Lights on but not occupied
- Occupancy cross tuning of HVAC and Lighting

With multiple systems, over millions of square feet, with thousands of data points, there must be a plan to deal with the deluge of information.

File Edit View History Bookmarks Tools Help
mozilla thunderbird
https://alturaanalytics.com/proj/uicirvine
Home
Folio
Func
Settings
User
Debug
Help
Alarm
Builder
Connectors
Control
Energy
Equip
FINStack
Historian
Job
KPI
Note
Report
Site Spark
Spark
StackHub
Weather

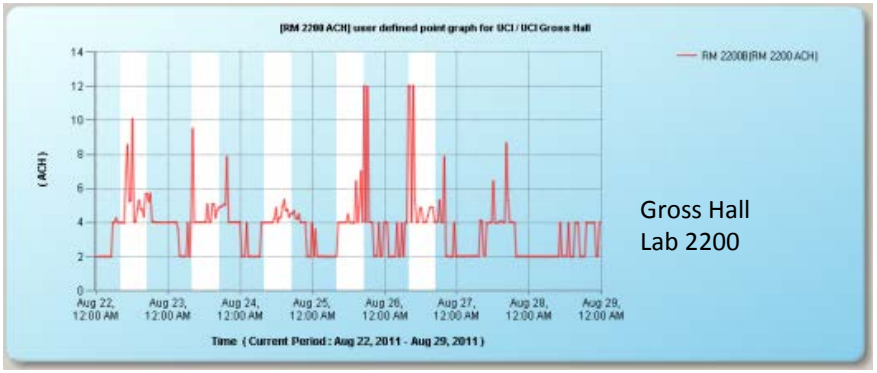

Targets
Today
View
Timeline
Rules
Select
Info
Aspects
All
Reines Hall
Group
Rules
dur
Timelines
Targets
Reines Hall 2 Main Electric Meter
1 sparks
kW too High
6.98hr
Reines Hall Chemistry 1st Flr 1001 WET LAB SAV-103
1 sparks
Space Temperature Above Setpoint
1.83hr
Reines Hall Chemistry 1st Flr 1002 WET LAB SAV-101
1 sparks
Space Temperature Above Setpoint
3.92hr
Reines Hall Chemistry 1st Flr 1002 WET LAB SAV-102
1 sparks
Space Temperature Above Setpoint
4.17hr
Reines Hall Chemistry 1st Flr 1002 WET LAB SAV 108
1 sparks
Space Temperature Above Setpoint
3.92hr
Reines Hall Chemistry 1st Flr 1002C WET LAB SAV-110
1 sparks
Space Temperature Below Setpoint
8.92hr
Reines Hall Chemistry 1st Flr 1002D WET LAB SAV-109
1 sparks
Space Temperature Above Setpoint
8.92hr
Reines Hall Chemistry 1st Flr 1028 WET LAB SAV-104
2 sparks
Space Temperature Above Setpoint
12.42hr
Space Temperature Below Setpoint
20min
Reines Hall Chemistry 1st Flr 1028 WET LAB SAV-112
1 sparks
Space Temperature Above Setpoint
20min



Hewitt
Hall
Lab 2501

- Air change rates are dependent on sash position and thermal demand.
- Lab 2501 averages 8 air changes per hour

- Air change rates are dynamic responding to occupancy, IAQ, sash position, and thermal demands
- Lab 2200 averages 4 air changes per hour



Gross Hall
Lab 2200

What We Learned Since 2010

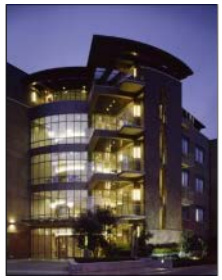
- “Digital-savvy” tradespeople increasingly essential to keep smart buildings smart
- Beliefs and attitudes are as important to success as technology, financing, and management
- No safety compromises were made for energy efficiency.
- Our most optimistic goals were too low!

UCI Smart Labs™ Initiative

Laboratory Building		BEFORE Smart Lab Retrofit			AFTER Smart Lab Retrofit		
Name	Type	Estimated Average ACH	VAV or CV	More efficient than code?	kWh Savings	Therm Savings	Total Savings
Croul Hall	P	6.6	VAV	~ 20%	40%	40%	40%
McGaugh Hall	B	9.4	CV	No	57%	66%	59%
Reines Hall	P	11.3	CV	No	67%	77%	69%
Natural Sciences 2	P,B	9.1	VAV	~20%	48%	62%	50%
Biological Sciences 3	B	9.0	VAV	~30%	45%	81%	53%
Calit2	E	6.0	VAV	~20%	46%	78%	58%
Gillespie Neurosciences	M	6.8	CV	~20%	58%	81%	70%
Sprague Hall	M	7.2	VAV	~20%	71%	83%	75%
Hewitt Hall	M	8.7	VAV	~20%	58%	77%	62%
Engineering Hall	E	8.0	VAV	~30%	59%	78%	69%
Averages		**8.2**	**VAV**	**~20%**	**57%**	**72%**	**61%**

Type: P = Physical Sciences, B = Biological Sciences, E = Engineering, M = Medical Sciences

- Many HVAC deferred maintenance problems fixed/funded through energy savings
- “Information layer” provides real-time commissioning and air quality track-record
- Lighting quality improved
- Quieter buildings inside and outside
- Cleaner indoor air
- Longer service life for heat-producing and friction-producing building system components
- Avoided capital investments for generation, central plant chillers, and infrastructure



Presented Monday, May 15, at the 2017 Better Buildings Summit, Washington, D.C.

© 2017 Regents of the University of California

UCI University of California, Irvine

Solution Sharing

U.S. DEPARTMENT OF ENERGY

Better Buildings®
U.S. DEPARTMENT OF ENERGY

Smart Labs Accelerator Partner Meet-Up

Solution Sharing

May 15, 2017

1:30-5 p.m.

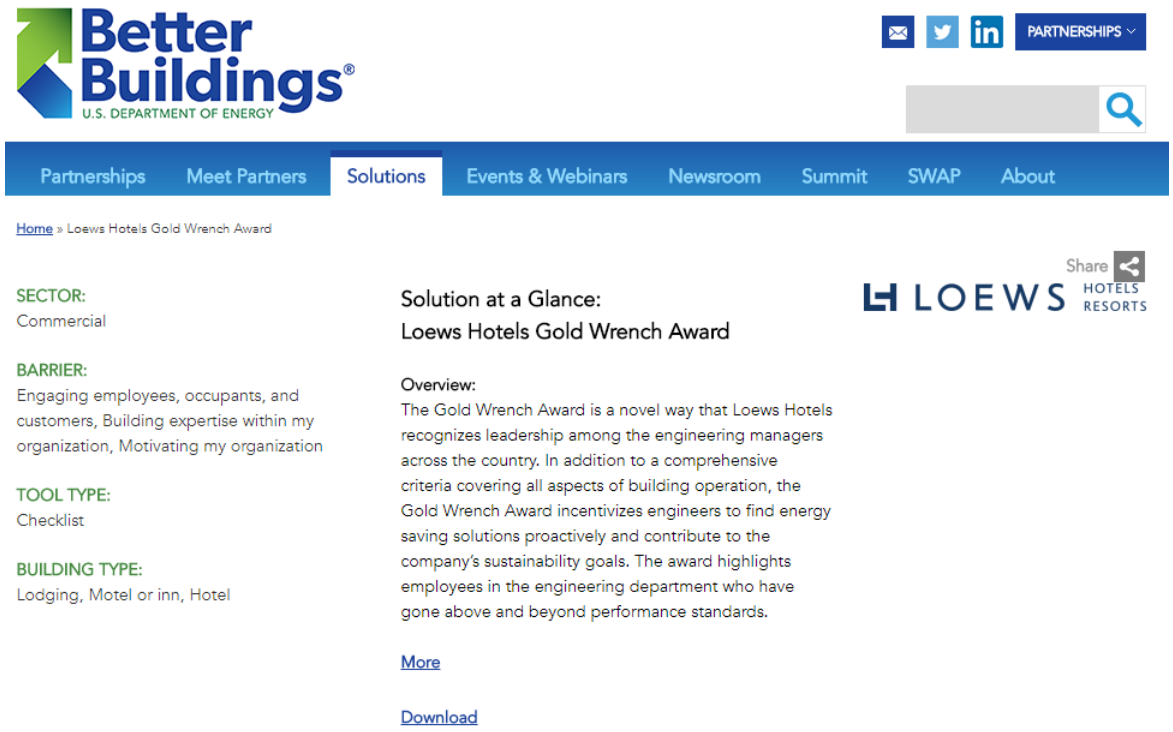
U.S. DEPARTMENT OF ENERGY

Solution Sharing

- Solution sharing is a key goal of all Better Buildings programs
- By broadly sharing what works, we can accelerate energy efficiency adoption in the market
- It is also an opportunity to recognize your organization for its efforts and success
- Your commitment to transparency is a true sign of leadership

Solutions-at-a-Glance

- Short write-ups
- Emphasis is on innovative projects and practices
- Should link to a key tool or resource
- Topics covered have included: internal recognition programs, checklists for capex, employee engagement resources



Showcase Projects

Better Buildings
U.S. DEPARTMENT OF ENERGY

PARTNERSHIPS

Partnerships | Meet Partners | Solutions | Events & Webinars | Newsroom | Summit | SWAP | About

Home » Solutions » Showcase Projects » Smart Labs Initiative/Natural Sciences II

Share

Natural Sciences II

Showcase Project: Smart Labs Initiative/Natural Sciences II

UC Irvine

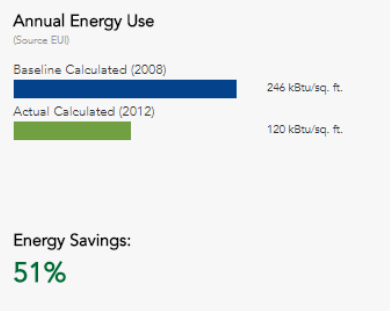
SECTOR TYPE
Commercial, Education

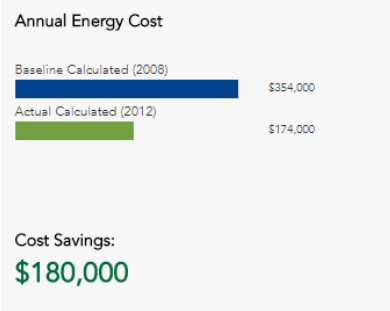
LOCATION
Irvine, California

PROJECT SIZE
146,000 Square Feet

FINANCIAL OVERVIEW
Project Cost: $829,864, with utility incentive of $416,442

Note: The UC Irvine data is a combination of metered data from variable frequency drives controlling equipment and building management system trends to create a model for building performance. This approach was used to focus on energy used by the building systems and exclude the energy used by laboratory process activities.

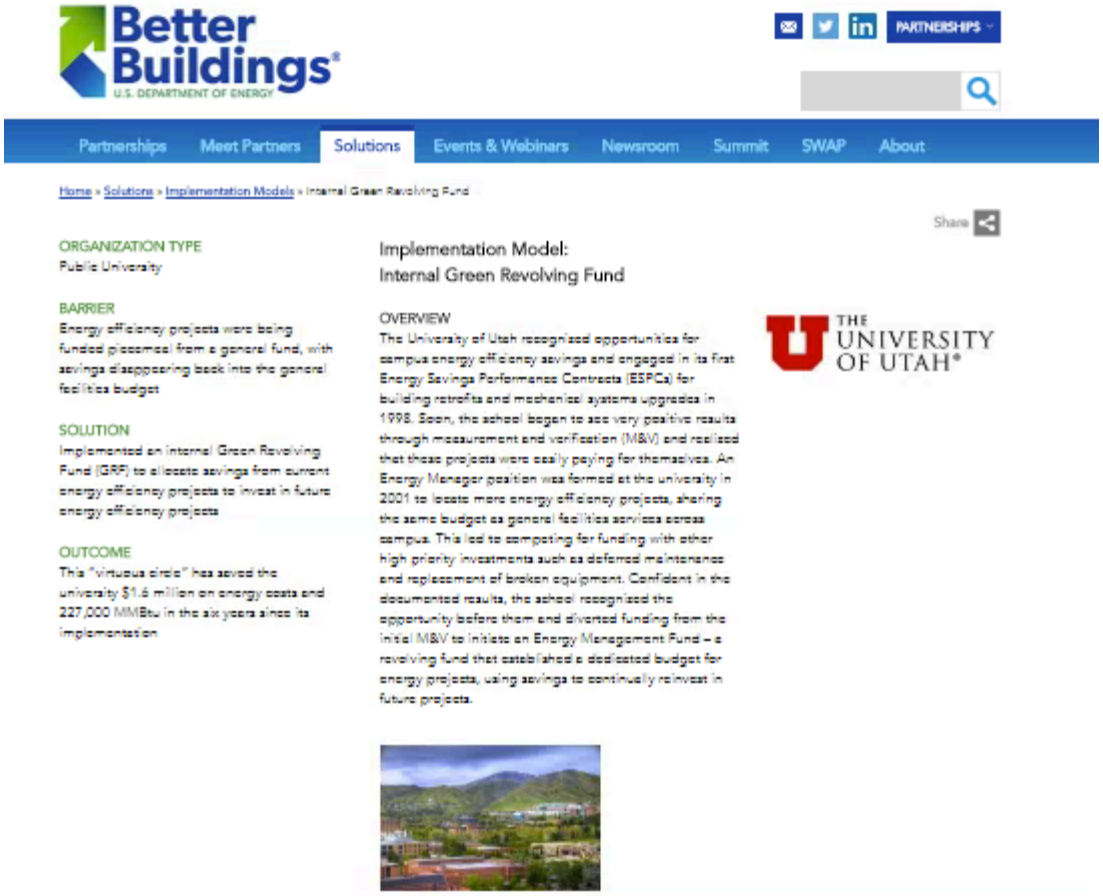




- Longer write-ups that focus on whole building improvement
- Provide detail on technical steps and measures taken to achieve savings
- Could be good way to highlight 5% savings at individual lab

Implementation Models

- Comprehensive write-ups that describe an organization-wide approach to advancing energy efficiency
- Broad topics covered include: finance, employee engagement, training programs
- Should link to specific tools and resources tied to the strategy and/or its execution



Better Buildings
U.S. DEPARTMENT OF ENERGY

PARTNERSHIPS

Partnerships | Meet Partners | Solutions | Events & Webinars | Newsroom | Summit | SWAP | About

Home » Solutions » Implementation Models » Internal Green Revolving Fund

Share

ORGANIZATION TYPE
Public University

BARRIER
Energy efficiency projects were being funded piecemeal from a general fund, with savings disappearing back into the general facilities budget

SOLUTION
Implemented an Internal Green Revolving Fund (GRF) to allocate savings from current energy efficiency projects to invest in future energy efficiency projects

OUTCOME
This "virtuous circle" has saved the university $1.6 million on energy costs and 227,000 MMBtu in the six years since its implementation

Implementation Model:
Internal Green Revolving Fund

OVERVIEW
The University of Utah recognized opportunities for campus energy efficiency savings and engaged in its first Energy Savings Performance Contracts (ESPCs) for building retrofits and mechanical systems upgrades in 1998. Soon, the school began to see very positive results through measurement and verification (M&V) and realized that these projects were easily paying for themselves. An Energy Manager position was formed at the university in 2001 to locate more energy efficiency projects, sharing the same budget as general facilities services across campus. This led to competing for funding with other high priority investments such as deferred maintenance and replacement of broken equipment. Confident in the documented results, the school recognized the opportunity before them and diverted funding from the initial M&V to initiate an Energy Management Fund – a revolving fund that established a dedicated budget for energy projects, using savings to continually reinvest in future projects.

THE UNIVERSITY OF UTAH®

Partner Only Page

- DOE is developing password-protected web pages available only to Accelerator partners
- Space can be used to post documents for sharing with other Accelerator partners (but not the general public)
- More to come soon

Thank You

Provide feedback on this session in the new Summit App!

Download the app to your mobile device or go to **bbsummit.pathable.com**