A Sustainable Focus for Laboratory Design, Engineering, and Operation

Federal Utilities Partnership

May 23, 2013

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(For Beth Shearer, I2SL Board of Directors)

AGENDA

- Labs 21 and the International Institute for Sustainable Laboratories (I^2SL)
- Recent partnership changes
- New initiatives
- Energy efficiency opportunities
- Laboratories and High-Tech facilities third party financing and DSM programs

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Purpose of I²SL

Laboratories for the 21st Century (Labs21®) – I²SL Partnership

- Dedicated to improving the environmental performance of U.S. laboratories
- Supporting the mission of Labs21
- Established in 1999, Labs21 program includes
  - Over 5,000 members of the Labs21 Network
- Annual conference and workshops
- I²SL is a member-driven organization

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Purpose of I²SL

I²SL Vision and Mission

- Vision
  - To enable a global network of collaboration to move laboratories and other high-technology facilities into balance with the natural world, available resources, and a flexibility that maintains and exceeds the technological standards necessary to meet their purposes over time.
- Mission
  - That of Labs21, to teach, share, and promote the development of sustainable high-performance facilities worldwide.

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RECENT CHANGES

- The US EPA has given Labs21 program responsibility to I²SL
- I²SL and DOE FEMP signed a Collaborative Agreement
- Labs21 Tools and Case Studies available at FEMP and I2SL Websites
- Annual Conference re-named to I²SL Annual Conference
- 2013 I²SL Annual Conference September 23-26 Minneapolis

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I²SL Builds On Labs21 Accomplishments

- Quarterly e-Newsletter, the *Sustainable Laboratory Times*
- Expanding involvement through a Global Community
- Open invitation to shape program through memberships
- Targeted Working Groups
- Facilitate Project Technical Assistance
- Expanded Training via monthly webinars

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New Initiatives

- I^2SL Chapter Development
- BIM for Operations and Management
- Training and Certification for High Tech O&M
- A Continuous Performance Improvement Program (CPIP)
- Third Party Financing for Labs and Related High-Tech Facilities

I²SL Chapter Development

- How-To “Chapter Kit” now available: http://i2sl.org/documents/globcomm/i2sl_chapter_kit.pdf
- Colorado, Illinois and Singapore chapters forming
- Pennsylvania, Massachusetts, Wisconsin and Georgia under consideration
- Open Meeting for interested chapters at 2013 I²SL Annual Conference in Minneapolis

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Building Information Modeling (BIM) for Operations and Management

- I^2SL, National Institute for Buildings Science (NIBS) and International Facilities Management Association (IFMA) survey released in Fall 2012
- Results encourage operations and management tools for BIM platform
- Survey summary article to be published in June issue of Journal of BIM by NIBS
- Meeting at 2013 I^2SL Annual Conference to present and discuss current client BIM projects incorporating operations/management

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Training/Certifying High-Tech Operations and Management

- Laney College, Oakland CA, a National Science Foundation (NSF) Center of Excellence, and I²SL have identified knowledge, skills, attitudes (KSA) gaps in existing training
- These gaps have been discussed at the last few Labs21 Annual Conferences
- I²SL and Laney issued a survey to validate this finding and to identify the processes to assess next steps
- Survey is available at: **http://www.surveymonkey.com/s/high-tech-O-M**

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Continuous Performance Improvement Program (CPIP)

- Co-Chaired by University of Minnesota with I^2SL
- Three functioning sub-working groups
  - Metering and sub-metering
  - User behaviors and
  - Lab equipment
- Plan to incorporate into existing certifications/accreditations
- Planned meeting at 2013 I^2SL Annual Conference

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Third party financing and utility incentive programs: The Need

- Large labs, including Federal labs, use huge quantities of energy for heating, cooling, lighting and process uses to support their research activities. The average lab facility uses 3 to 10 times as much energy (per sq ft) as a comparable office building.
- Labs and other high-tech facilities have unique characteristics:
  - Labs often require 100% outside air to meet ventilation requirements. Laboratories containing hazardous chemicals must be maintained under negative pressure.
  - Process equipment such as fume hoods and sterilizers drive up energy use.
  - Most systems cannot be shut down during a retrofit. Much of the work must be done during off-peak hours, requiring premium time labor at higher costs.
- Federal agencies do not have the funds for retrofits and must rely on third-party financing and utility incentive programs.

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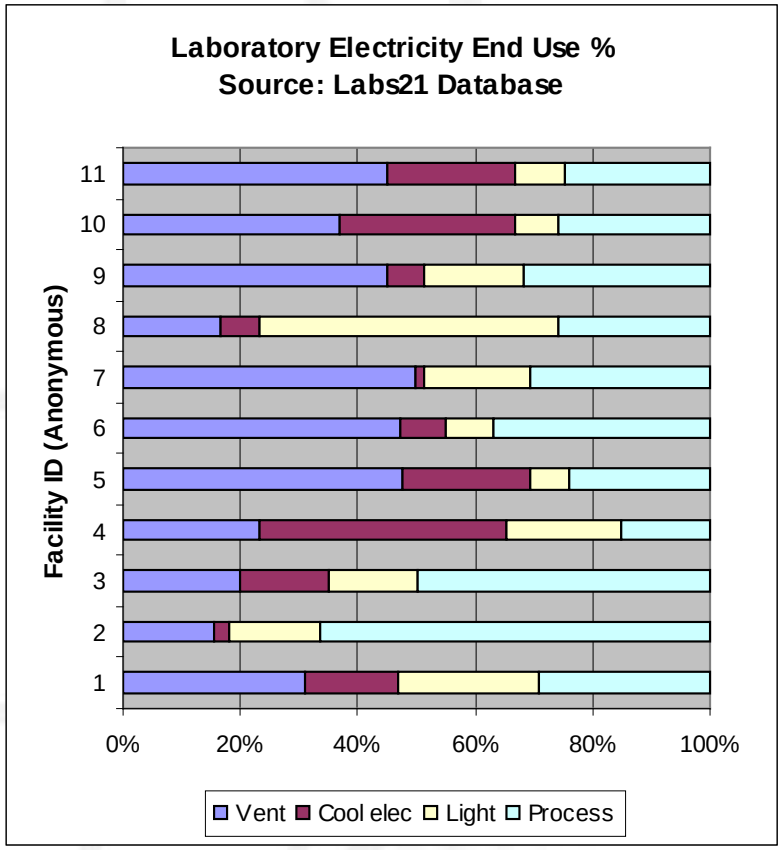
Lab Energy Use is Dominated by HVAC



- HVAC is the largest component of energy consumption in most labs
  - % varies by lab type and location
- In some labs, 10-20% savings in ventilation is equivalent to total lighting energy use

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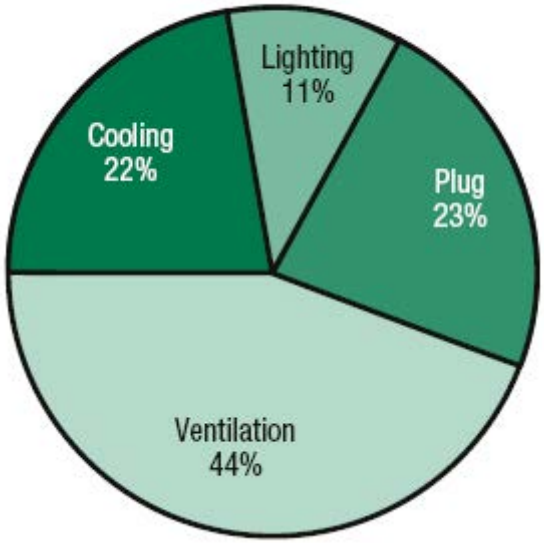
Five BIG HITS

1. Scrutinize the air changes:
   Optimize ventilation rates
2. Tame the hoods:
   Compare options
3. Drop the pressure drop:
   Use lower pressure-drop HVAC designs
4. Get real with plug loads:
   Right-size HVAC systems
5. Just say no to re-heat:
   Minimize simultaneous heating and cooling



Annual electricity use in Louis Stokes Laboratory, National Institutes of Health , Bethesda, MD

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#1 Scrutinize the Air Changes

Air change rates have large peak and total cost impact

- Don’t assume air changes are driven by thermal loads
- Question minimum air change rate (ACR)?
  - Why? Why? Why?
- When is ten or more air changes safe and six air changes (or less) not?

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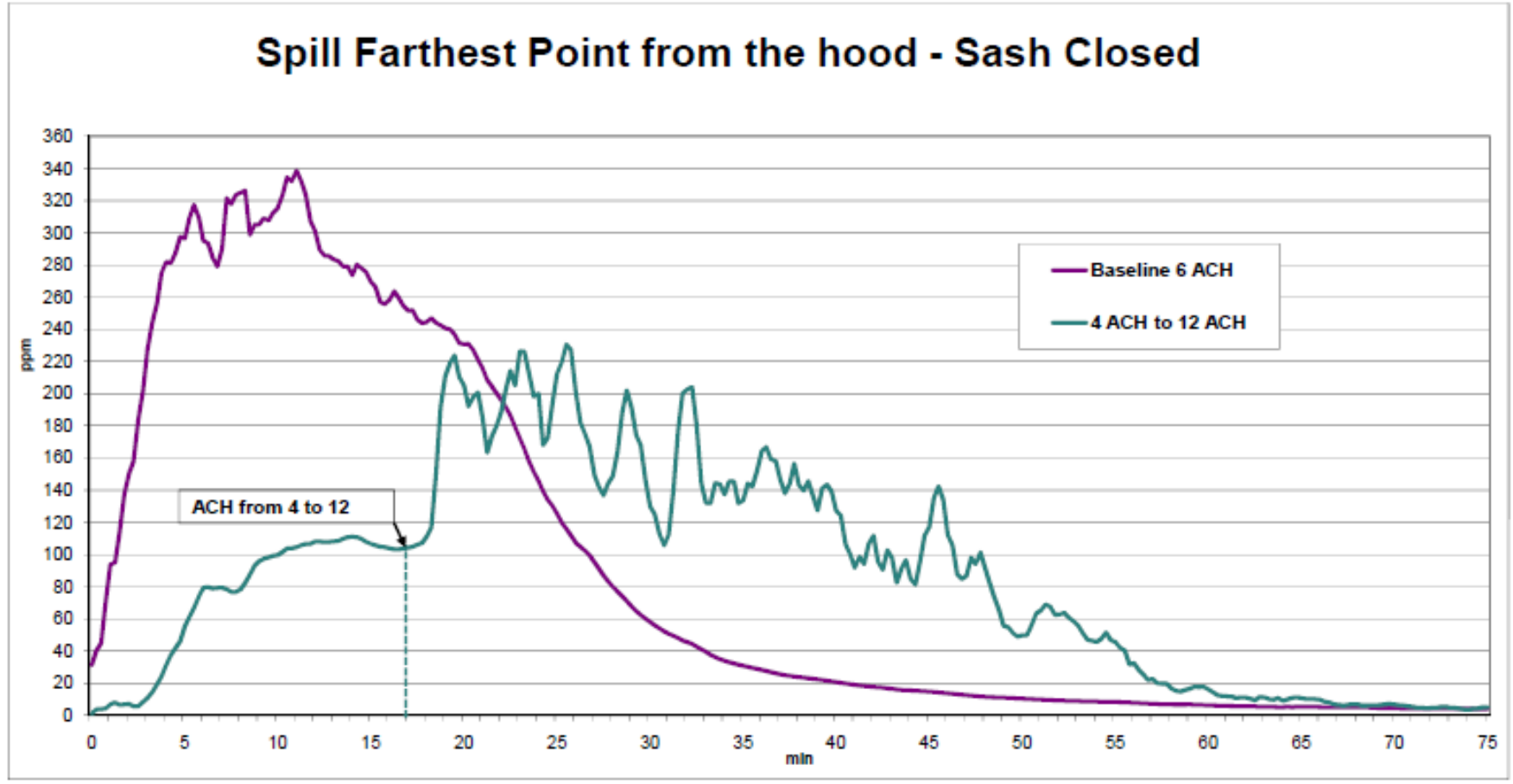
Scrutinize the Air Changes

- Options to consider
  - cfm/sqft rather than ACR
  - Panic switch concept
  - Cascading air from clean to dirty
  - Setback ACR when lab is unoccupied
  - Control Banding (one rate doesn't fit all)
  - Modeling and simulation for optimization
  - Demand controlled ventilation (based on monitoring of hazards and odors), e.g. Centralized Demand Controlled Ventilation (CDCV)
- Ventilation effectiveness is more dependent on lab and HVAC design than air change rates (ACR)
- High ACR can have a negative impact on containment devices

Test Results of CDCV



Courtesy of UC Irvine

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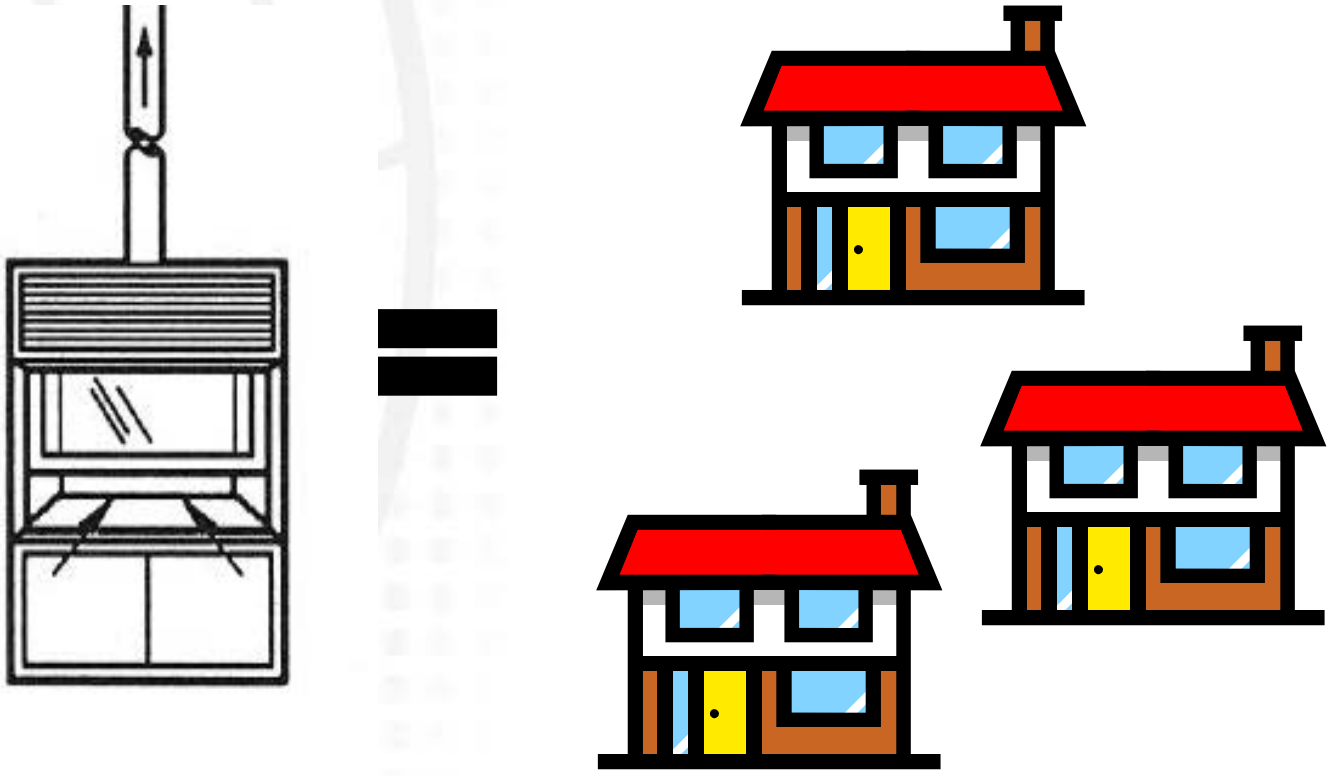
#2 Tame the Hoods

Fume hood Energy Consumption



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Tame the Hoods

1. Reduce the number and size of hoods
2. Restrict the sash opening
3. Use Two “speeds” occupied and un-occupied
4. Use variable air volume (VAV)
5. Auto sash closures
6. Consider high performance hoods

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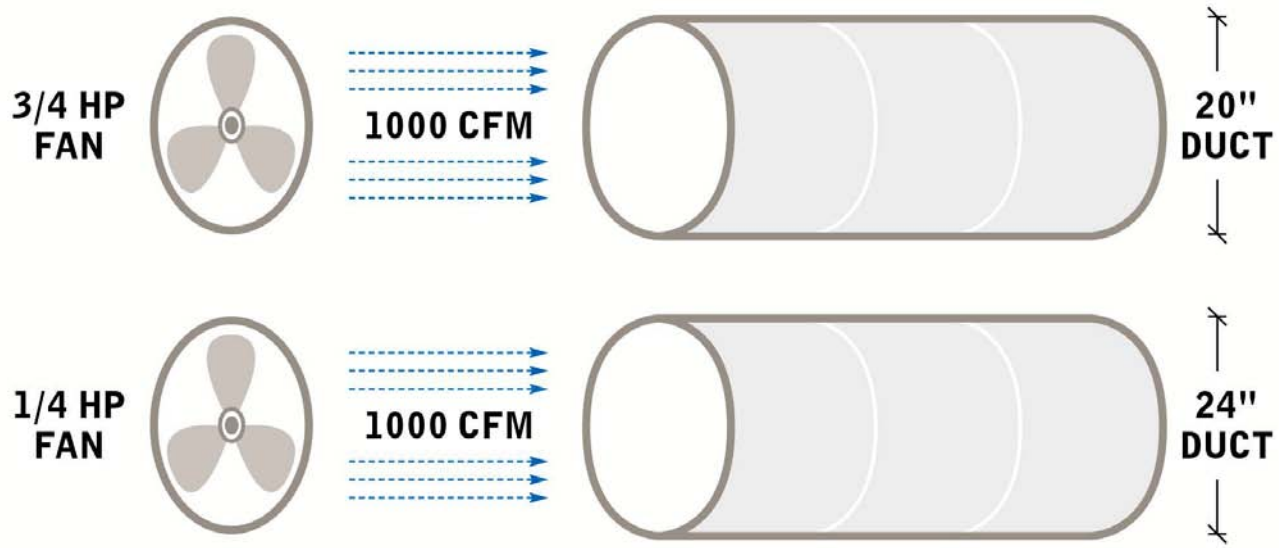
#3 Drop the Pressure Drop

- Up to one half HVAC energy goes to fans
- How low can you go?



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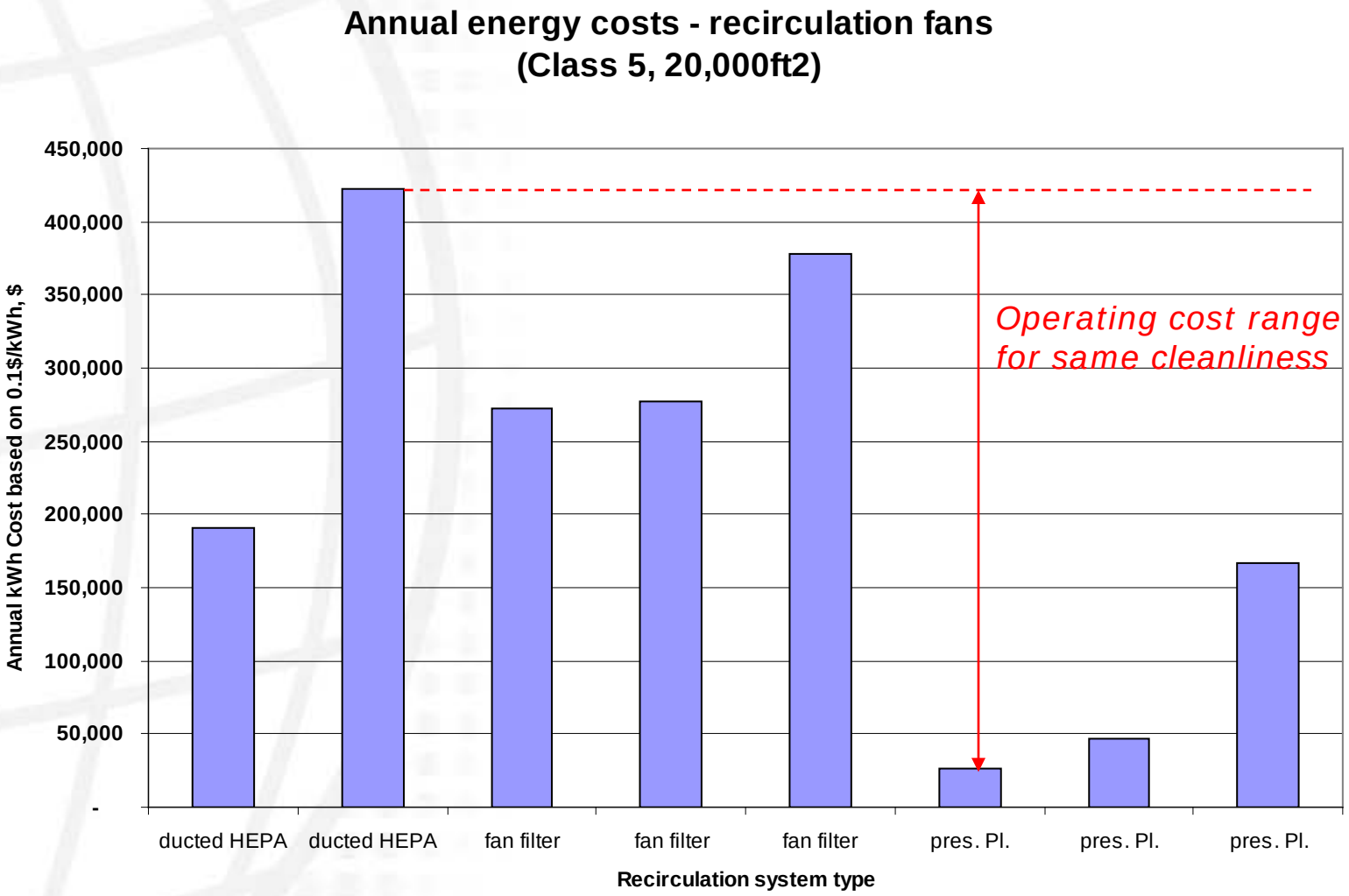
Annual Energy Cost for Cleanroom Recirculation Fans



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Low Pressure-Drop Design Guidelines

Component	Standard	Good	Better
Air handler face velocity	500	400	300
Air Handler	2.5 in. w.g.	1.5 in. w.g.	0.75 in.w.g.
Heat Recovery Device	1.00 in. w.g.	0.60 in. w.g.	0.35 in. w.g.
VAV Control Devices	Constant Volume, N/A	Flow Measurement Devices, 0.60 - 0.30 in. w.g.	Pressure Differential Measurement and Control, 0.10 in. w.g.
Zone Temperature Control Coils	0.5 in. w.g.	0.30 in. w.g.	0.05 in. w.g.
Total Supply and Return Ductwork	4.0 in. w.g.	2.25 in. w.g.	1.2 in. w.g.
Exhaust Stack	0.7” w.g. full design flow through entire exhaust system, Constant Volume	0.7” w.g. full design flow through fan and stack only, VAV System with bypass	0.75” w.g. averaging half the design flow, VAV System with multiple stacks
Noise Control (Silencers)	1.0” w.g.	0.25” w.g.	0.0” w.g.
Total	9.7” w.g.	6.2” w.g.	3.2” w.g.
Approximate W / CFM	1.8	1.2	0.6

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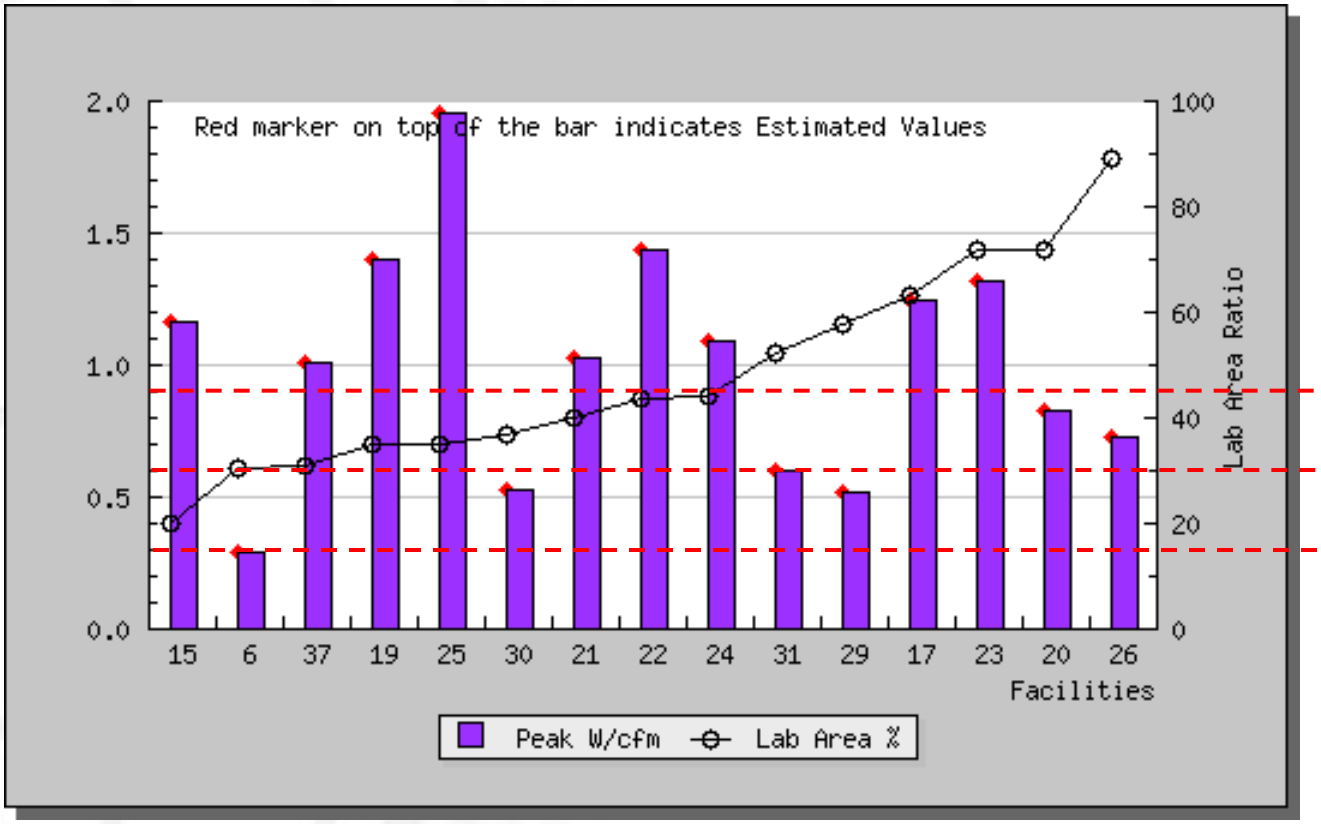
Labs21 Benchmarking Tool – Vent. W/cfm



Standard, good, better benchmarks as defined in
"How-low Can You go: Low-Pressure Drop Laboratory Design" by Dale Sartor and John Weale

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#4 Get Real with Plug Loads

- Save capital cost and operating cost
- Measure actual loads in similar labs
- Design for high part-load efficiency
  - Modular design approaches
- Plug load diversity in labs increases reheat
- Buy energy efficient equipment

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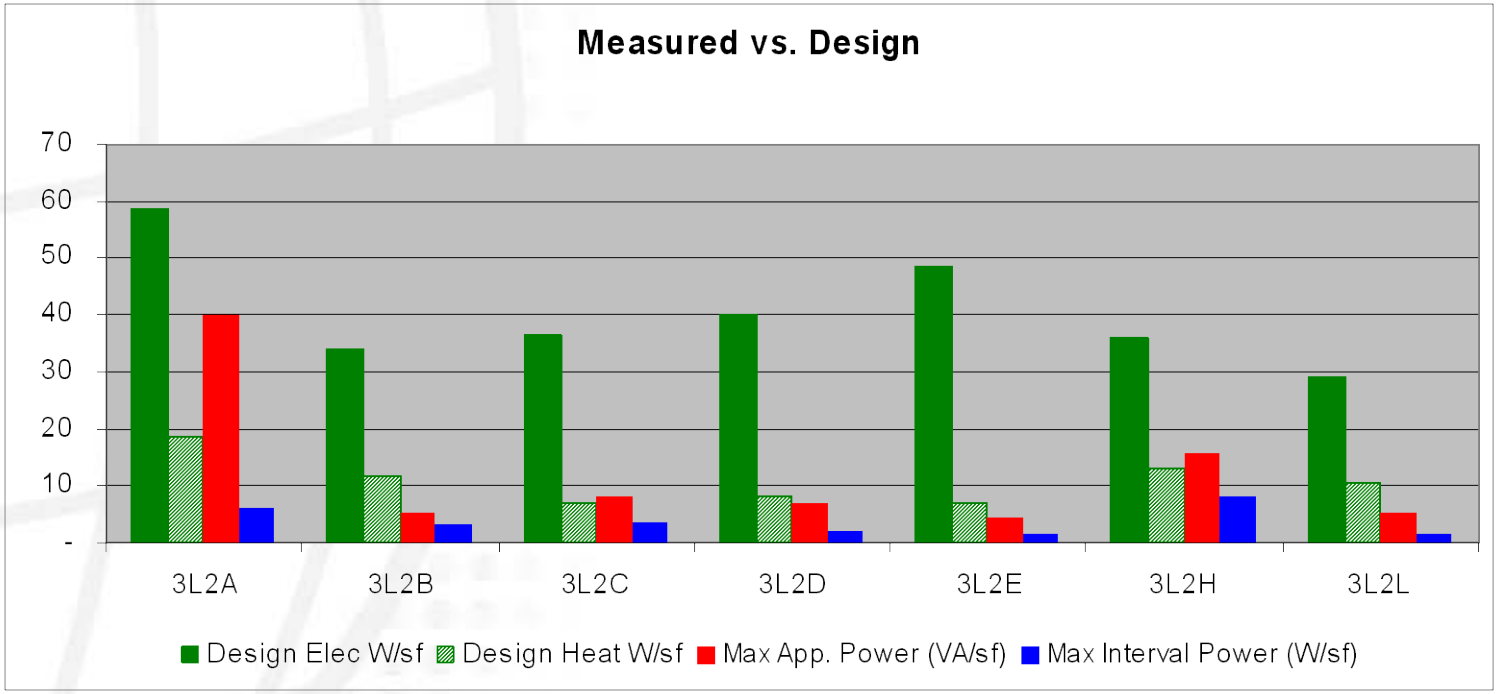
Measured vs. Design – UC Davis Case Study

- Significant over-sizing not unusual



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Measured Plug loads in Labs

- Sandia PETL Lab
  - Designed for 6 W/nsf;
  - Metered data: 1.8 W/nsf (avg.), 2.7 W/nsf (peak)
- Fred Hutch Cancer Research Center
  - Phase 1 designed for 15-30 W/nsf
  - Phase 2 reduced design to 8 W/nsf based on Phase 1 experience
- Pharmacia
  - Designed for 12 W/nsf
  - Metered data: 2.7 W/nsf

Benefits of Right-sizing at LBNL-MFL

- $2.5 million first cost savings for right-sizing HVAC systems
  - Based on measured data from comparable labs

- LEED Gold
  - Rightsizing savings allowed additional green features with 4% cost savings over baseline.

The Molecular Foundry
Lawrence Berkeley National Laboratory

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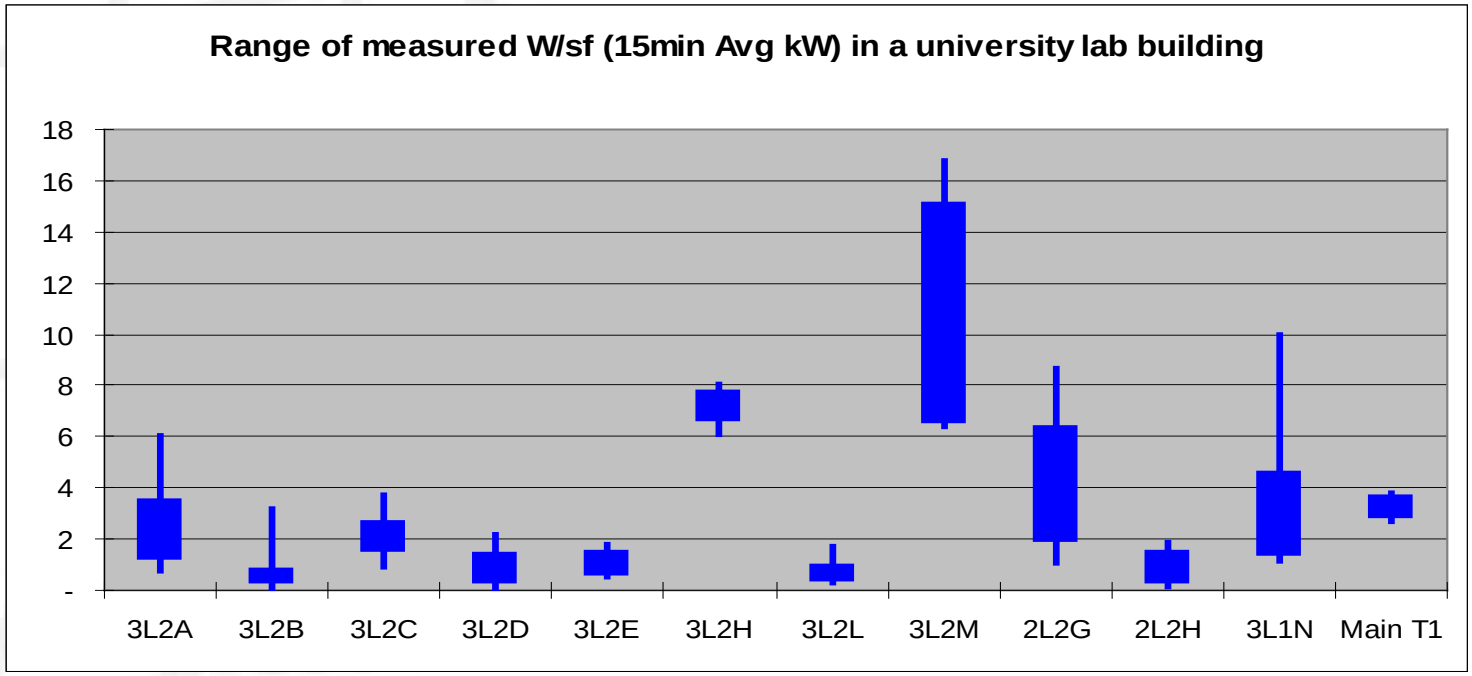
#5 Just Say No to Reheat

- Reheat (simultaneous heating and cooling) causes major energy use in labs
  - High-load areas require lower supply air temperature, so reheat occurs in other spaces



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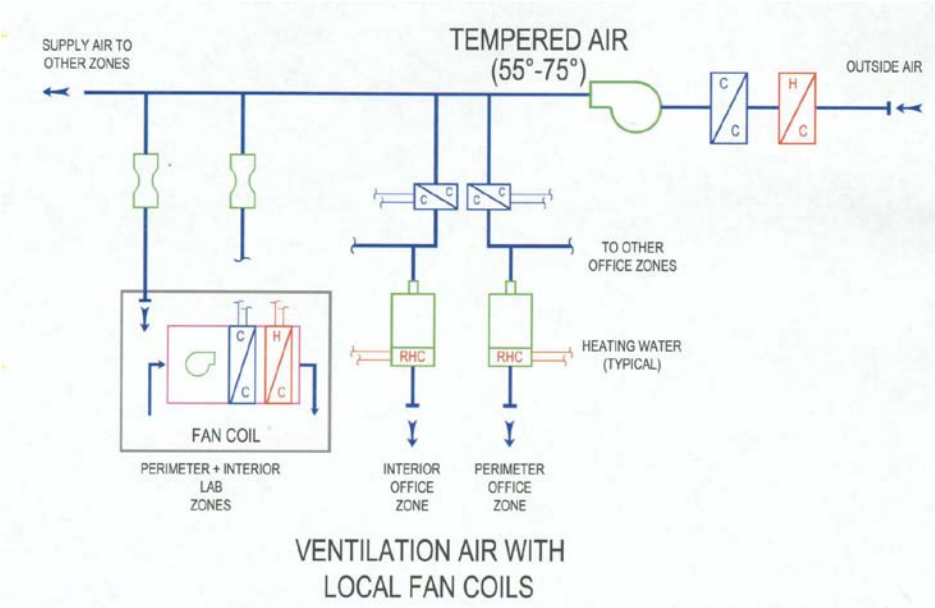
System Alternatives to Minimize Reheat

- Dual-duct systems
- Ventilation air with zone coils
- Ventilation air with fan coils
- Ventilation air with radiant cooling
- Ventilation air with inductive cooling coils (Cool Beams)



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ESPC and utility incentive programs: two examples

- ESPC: USDA Agricultural Research Service Center for Medical, Agricultural, and Veterinary Entomology (CMAVE), Gainesville, FL[1]
  - Savings:
    - 19% energy savings per year
    - 57% water savings per year
    - $131,963 annual cost savings
  - ECM examples
    - Ventilation system upgrades
    - Chiller replacement
    - HVAC controls update
    - Irrigation system sub-meter
    - Fume hood modifications

1. *Strategic Planning for Energy and the Environment*, Vol. 32, No. 4, 2013

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ESPC and utility incentive programs: two examples

ComEd *Smart Ideas:* **New Incentives for Laboratory Energy Efficiency**

•Laboratories -- in hospitals, pharmaceutical plants, college and university science departments and manufacturing facilities -- are major users of energy. The primary energy consumers in labs are the hoods that vent fumes away from workers. The following energy efficiency upgrades may now qualify for incentives from *Smart Ideas*:

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ComEd Laboratory Incentives

Constant Volume to Variable Air Volume Fume Hood	$250 per linear foot of hood
Automatic Fume Hood Sash Closer	$150 per linear foot of hood
Fume Hood Occupancy Controls	$100 per linear foot of hood
Low-Flow High-Performance Hood	$400 per linear foot of hood
Reduce/Optimize Lab Space Air Change per Hour (ACH) rate	$0.75 per CFM reduced
Sash Stops	$5 per linear foot of hood
Low Pressure Drop HEPA Filters	$50 per 1,000 CFM
Low Pressure Drop High Efficiency (Non-HEPA) Air Filters	$15 per 1,000 CFM

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I²SL-FEMP & ESCO Working Group

- Two conference calls: 3/21/13 and 5/25/13
- Working Group members defining challenges and solutions
- Proposed laboratory site visit to collectively identify the possible opportunities, hurdles, and value propositions for both the client and the program partners.
- Meeting planned for 2013 I²SL Annual Conference in Minneapolis, September 24-26

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Discussion: Utility Participation

- Would utilities like to participate in a manner similar to ESCOs?
- Should we form a FUPWG subgroup?
- Next steps?

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Labs21 Toolkit

- *Core information resources*
  - Design Guide
  - Case Studies
  - Energy Benchmarking
  - Best Practice Guides
  - Technical Bulletins
- *Design process tools*
  - Env. Performance Criteria
  - Design Intent Tool
  - Labs21 Process Manual

www.i2sl.org/resources/toolkit.html

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The Labs21 Annual Conference is now the

2013 I²SL Annual Conference

Premier training and exposition for
high-tech facility professionals

International Institute for Sustainable Laboratories™

Minneapolis Convention Center
Minneapolis, Minnesota
September 24–26, 2013

www.i2sl.org/conference

How to Get Involved

For more information and to discuss involvement:

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