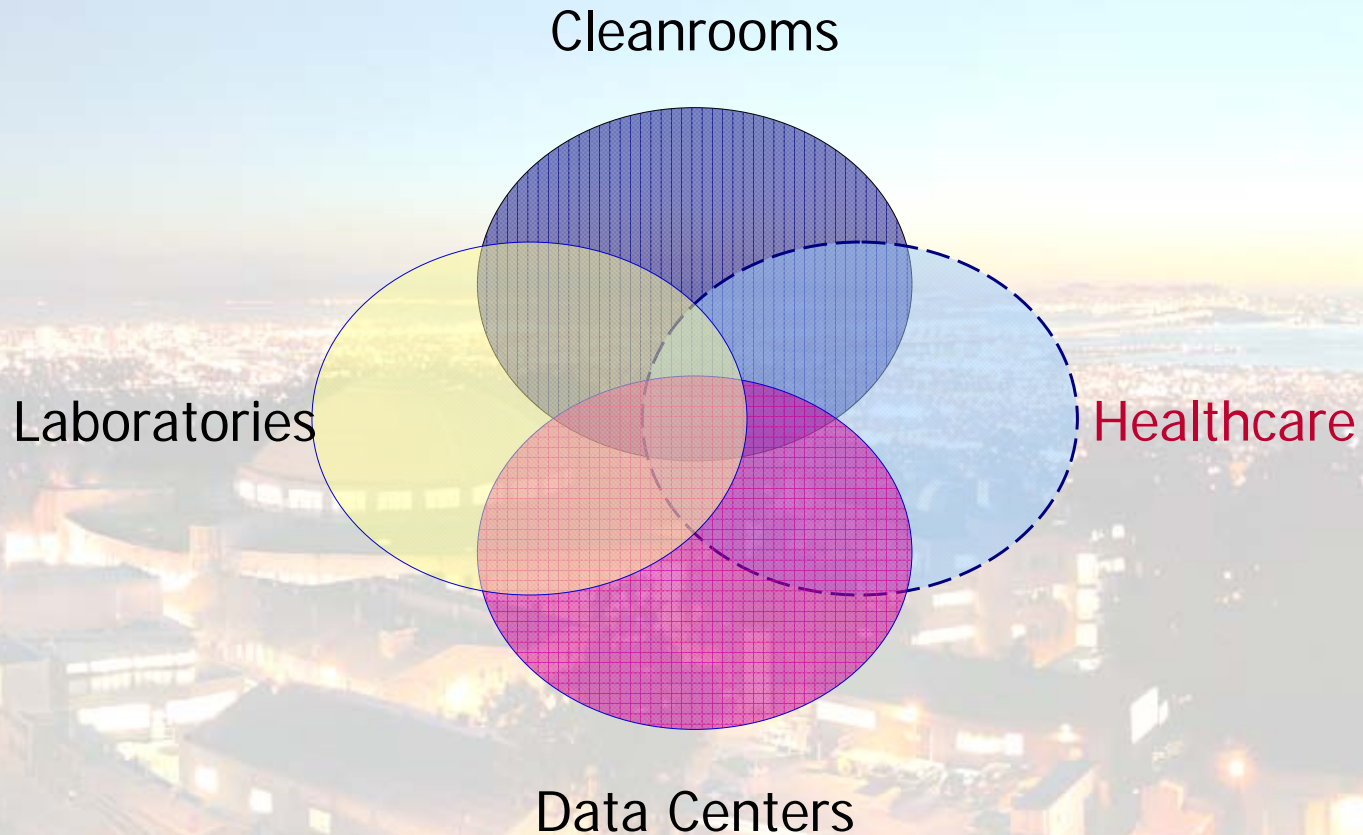


Energy Efficient Buildings for High Tech Industries - An Integrated R&D and Market Transformation Program

CEE Briefing
January 13, 2009

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Environmental Energy Technologies Division
Applications Team

Energy Intensive High-tech Buildings



Opportunities Are Real

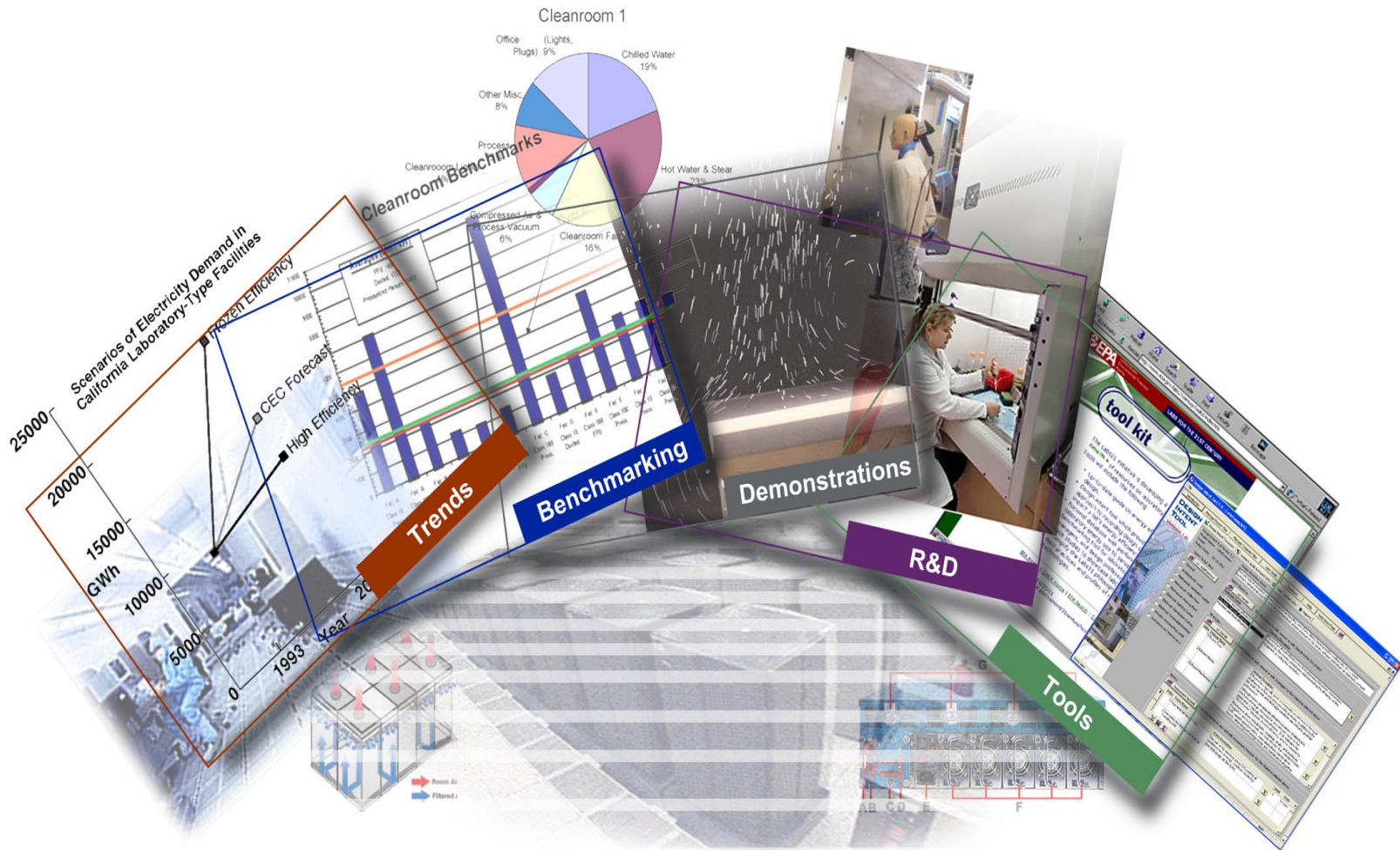


LBNL Example:

- 40% reduction in energy use per square foot from 1985 baseline
- \$4 million/year more research based on 1985 energy prices
- Improved worker productivity
- Safer environment
- Improved reliability



LBLN's High-tech Buildings Initiative – a wide breadth of activities



LBLN Website: <http://hightech.lbl.gov>

High-Tech Buildings Program Sponsors

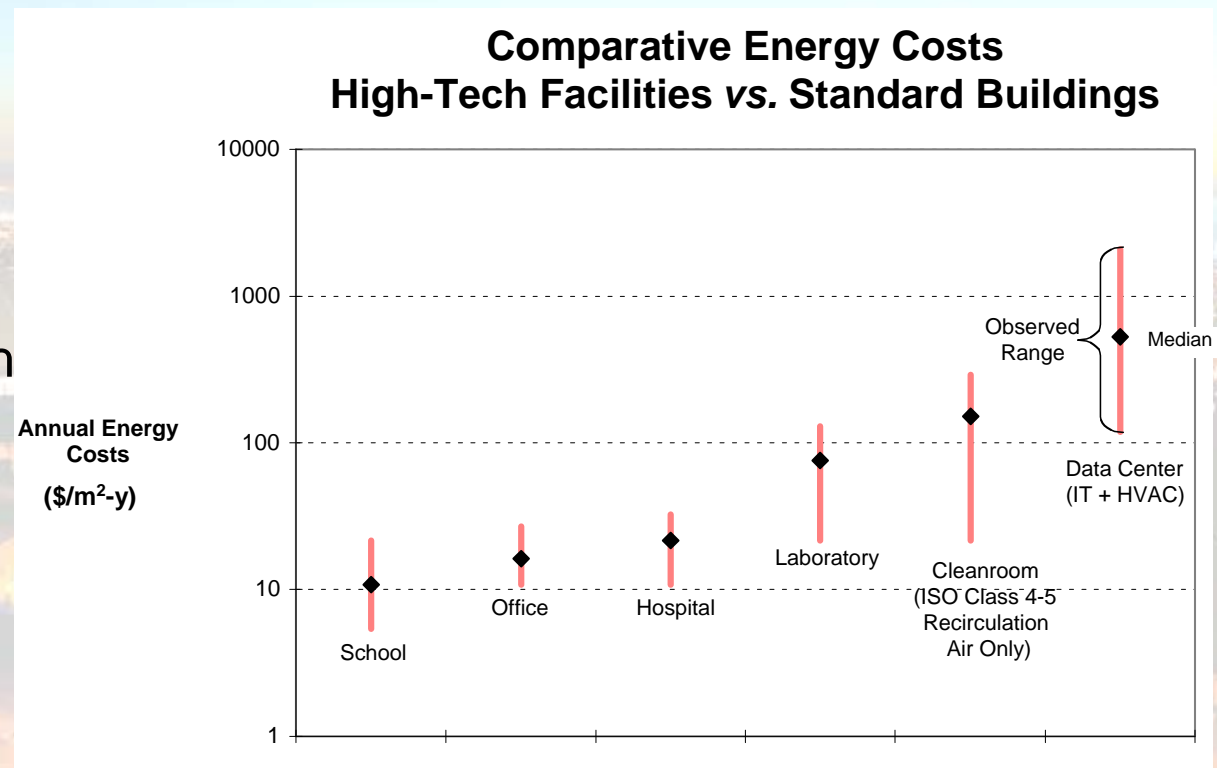


- *Pacific Gas & Electric Co.*
- *San Diego Gas and Electric Co.*
- *California Institute for Energy and Environment*
- *California Energy Commission*
- *Department of Energy (BT, ITP and FEMP)*
- *Environmental Protection Agency*
- *Northwest Energy Efficiency Alliance*
- *New York State Energy Research & Development Authority*
- *Private Industry (Organizations and Companies)*

Why High-tech Buildings?



- High-tech buildings are energy intensive
- Continuously operating
- “Process” load driven with unique environmental needs
- Growth industries with rising energy use
- Ripe for improvement - 40-50% energy savings potential
- Technology leaders



Cleanrooms: The Opportunity

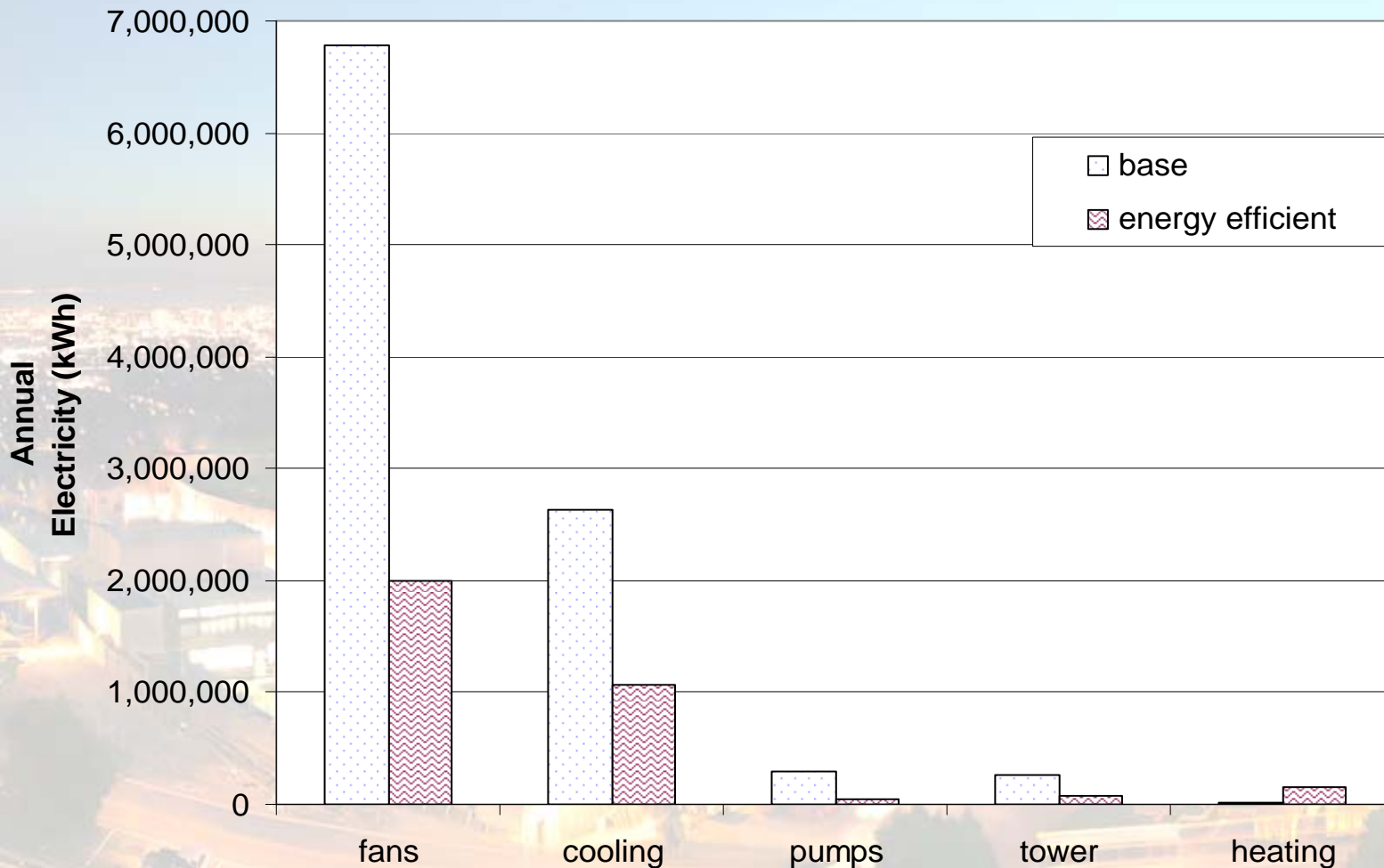
- Up to 100x more energy-intensive than typical buildings (Class-1 cleanroom can be up to 600 ac-h)
- Promising Measures
 - Govern ventilation by performance rather than rules of thumb
 - Improved process load projection to right size
 - More efficient HVAC
 - Low-pressure-drop design



Opportunities are Significant



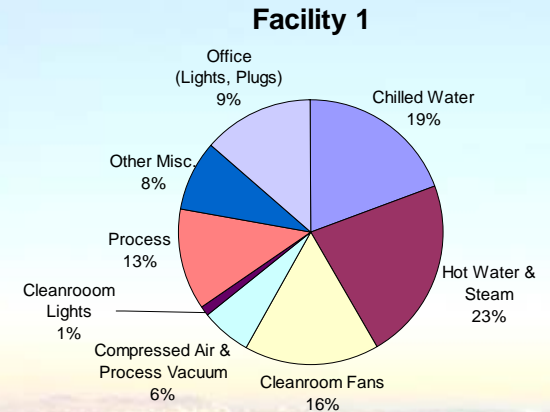
Cleanroom End-Use Energy Breakdowns



Cleanroom Activities



- **Benchmarking and Best Practices**
 - **Fan-filter unit test procedure**
 - **Demand-controlled filtration**
 - **Minienvironments**
-
- **Demonstration projects**
 - Fan-filter testing
 - Demand controlled filtration

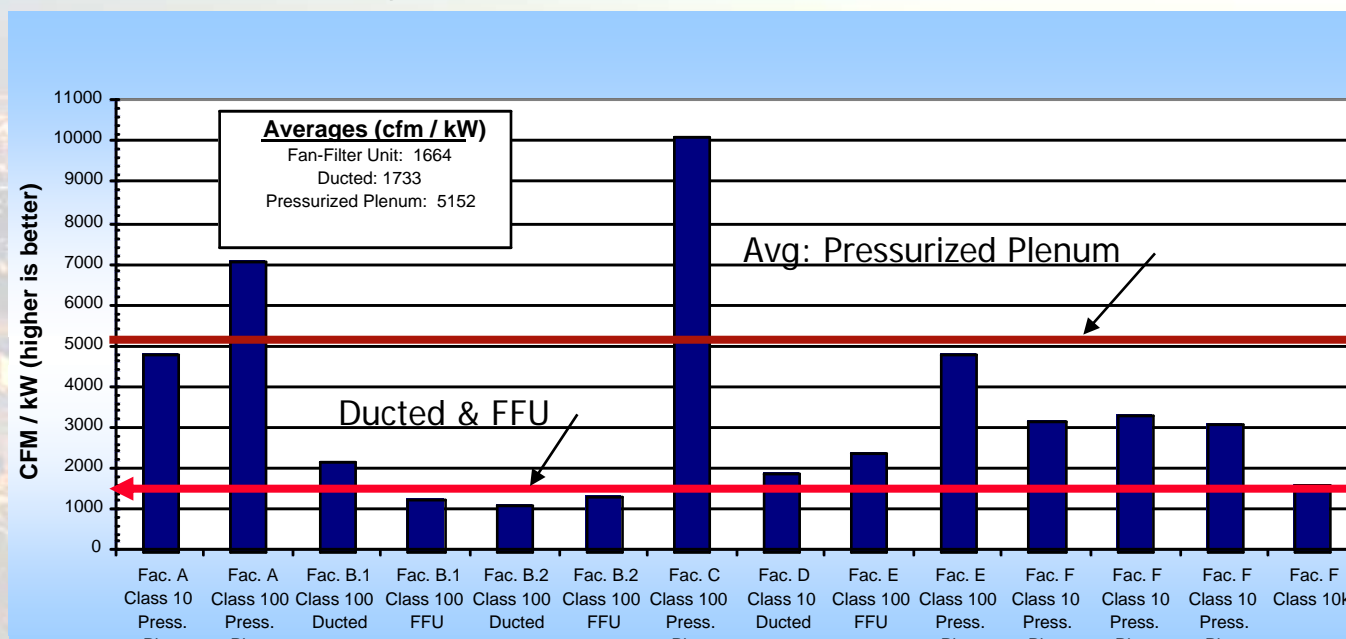


Benchmarking: Reveals a wide range of efficiencies



For example: cleanroom recirculation systems

Choice of air delivery strategy strongly influences energy intensity

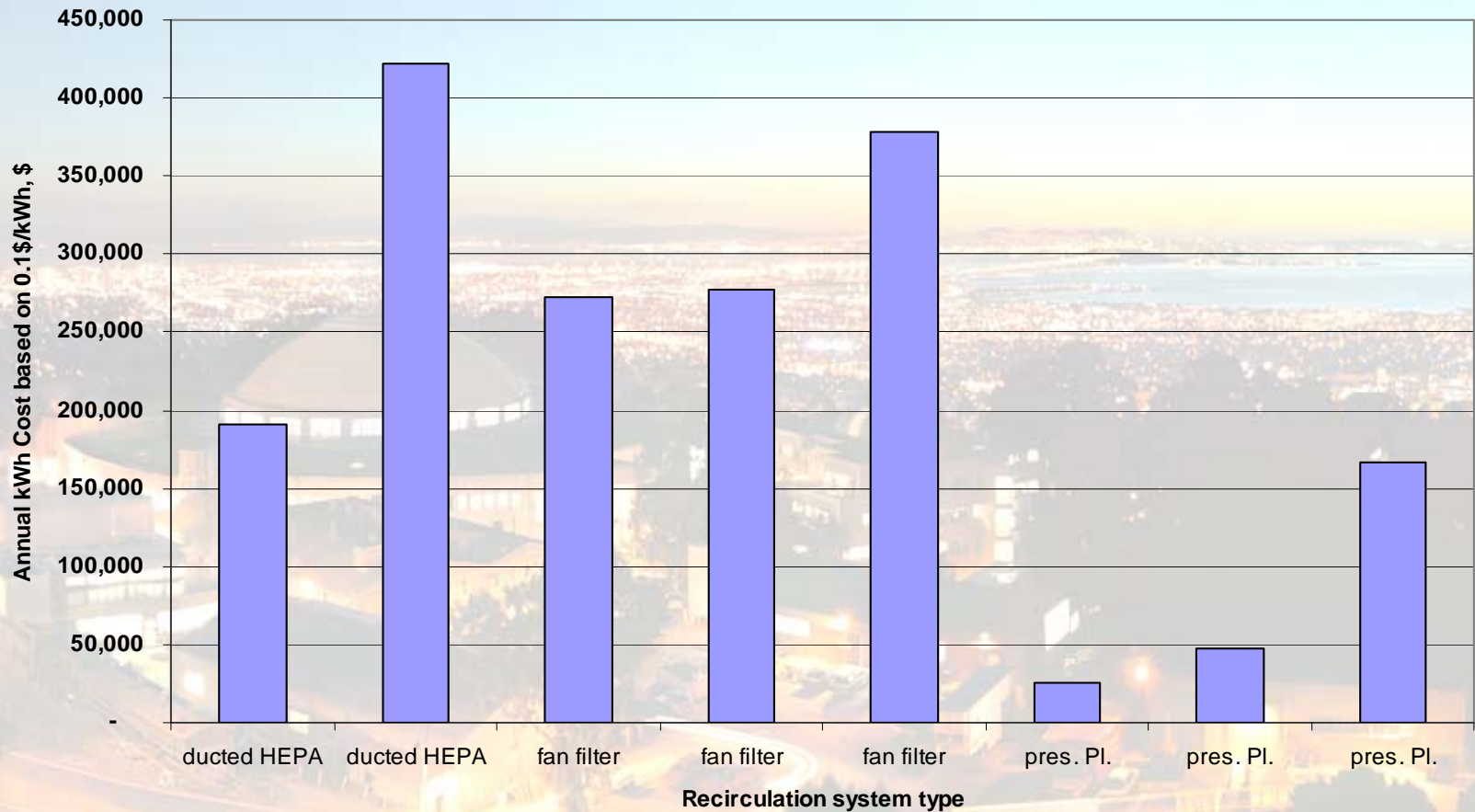


Comparison of ISO Class 5
Cleanrooms (ACH)

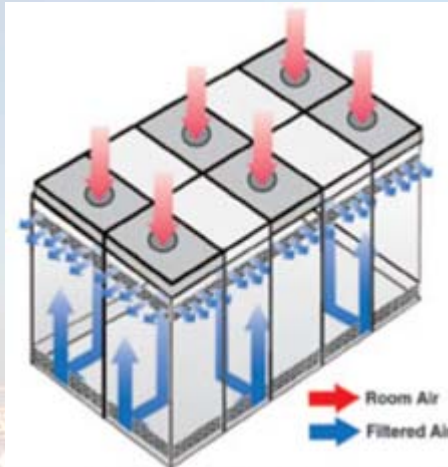
What is the cost impact?



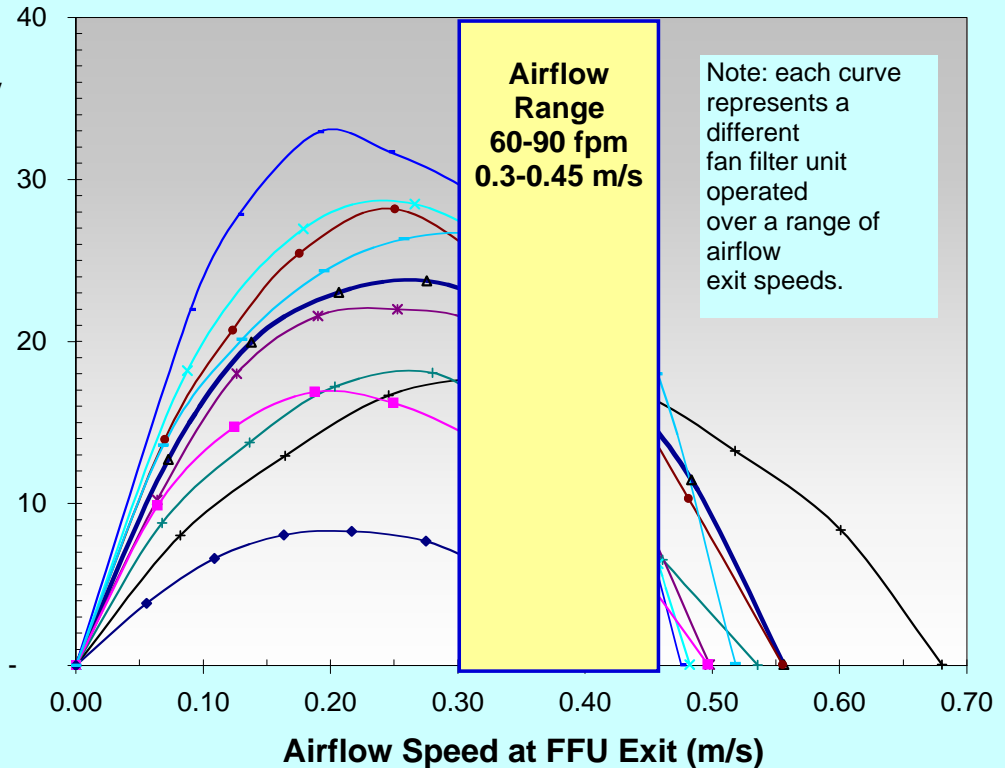
Annual energy costs - recirculation fans
(Class 5, 20,000ft²)



Fan-filter units



Total Pressure Efficiency (%)



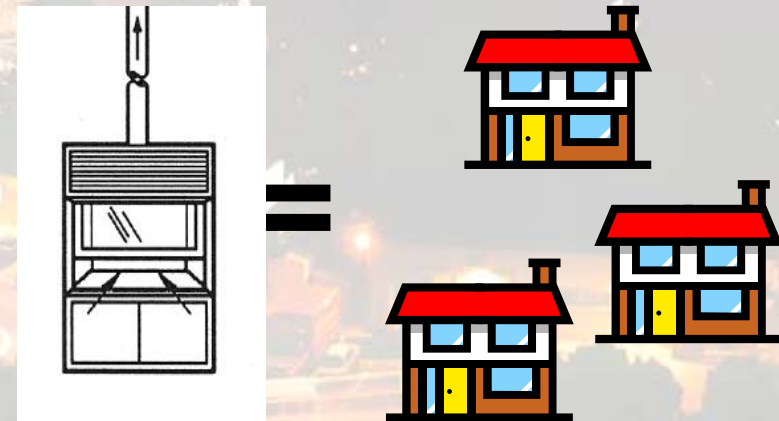
➤ Efficiencies vary by a factor-of-four

Laboratories: The Opportunity

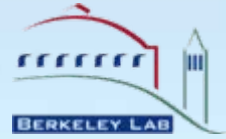
- Labs are 5x as energy-intensive as typical buildings; fume hoods use >3x as much energy as typical home
- Promising Measures
 - Low-pressure-drop design
 - Ventilation and hood flows governed by performance rather than rules of thumb
 - Minimize or eliminate reheat
 - Right size



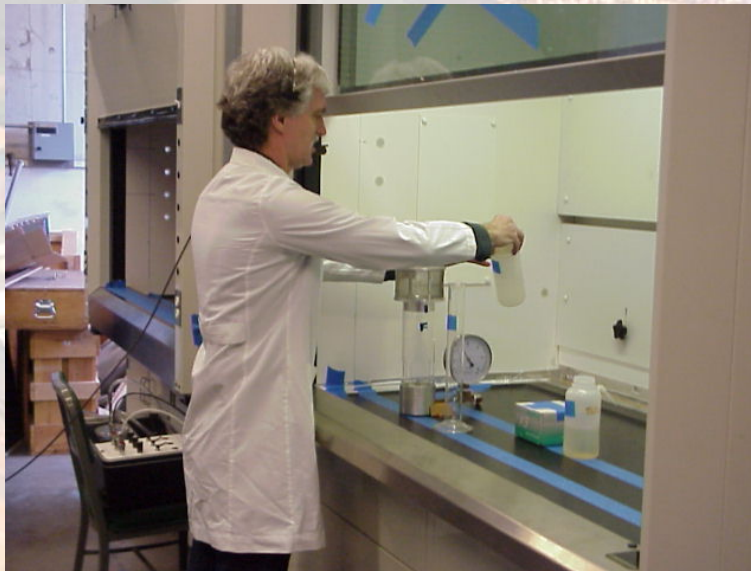
Berkeley Hood installed at UCSF



Laboratory Activities



- Benchmarking and Best Practices
- Berkeley Fume Hood
- Auto sash closure demo
- Labs 21 (DOE/EPA)



LBNL's Geoffrey Bell performing dynamic side-by-side tests comparing 6-foot Berkeley Hood with a standard hood.

High Performance Fume Hood Hoods



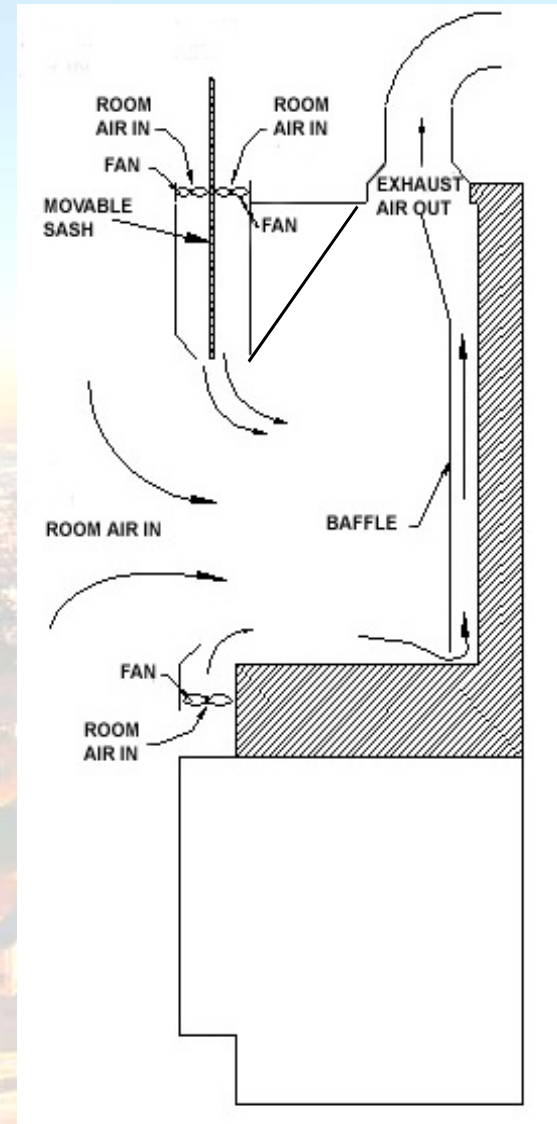
Objective:

**Reduce fume hood air
flow requirements at
least 50%**



The Berkeley Hood

- Patented push/pull design
- Utilities sponsored demonstrations
 - PG&E UCSF
 - SDG&E San Diego State
- Not accepted by Cal/OSHA



The Berkeley Hood is Not Alone!



- Innovations coming from industry
- Labconco “Protector Xstream”
- Fisher Hamilton “Pioneer”
- LabCrafters “Air Sentry”
- >> All have been tested per ASHRAE 110-1995 and pass ANSI/AIHA Z9.5-2002 at 60 FPM
- High Performance/Low Flow hoods accepted in all other states but many institutions specify a minimum face velocity





**labs for the
21st century**

Sponsored by:
U.S. Environmental Protection Agency
U.S. Department of Energy

Labs21 Program



A joint EPA/DOE-FEMP program to improve the environmental performance of U.S. laboratories

- Optimize whole building efficiency on a life-cycle basis**
- Assure occupant safety**
- Minimize overall environmental impacts of new and existing laboratories**
- LBNL and NREL provide core technical support**

www.labs21century.gov

Labs21 Program Components



- **Partnership Program**
 - Draws together lab owners and designers committed to implementing high performance lab design.
- **Training Program**
 - Includes annual technical conference, training workshops, and other peer-to-peer opportunities.
- **Tool Kit for Sustainable Design**
 - Resources for owners, designers, and operators

Labs21 Toolkit



The screenshot displays the Labs21 Toolkit interface. At the top, there's a navigation menu with options like 'Pre-Design', 'Schematic Design', 'Design Development', 'Construction Documents', 'Bid & Award', 'Construction', 'Acceptance and Close-out', and 'Occupancy and Operation'. The main content area is titled 'Design Process Checklist' and includes a 'Pre-Design' section with a checklist of items to ensure sustainability is integrated into the building design. Below this, there's a 'Main window' with a 'Contents' list and an 'Overview of manifold exhaust systems' article. To the left, there's a 'Case Study Index' for 'LABORATORIES FOR THE 21ST CENTURY: CASE STUDIES', featuring 'THE LOUIS STOKES LABORATORY BUILDING 50, NATIONAL INSTITUT OF HEALTH, BETHESDA, MARYL'. The bottom part of the screenshot shows a 'Graphing - Microsoft Internet Explorer' window displaying a 'benchmarking' page for 'Total Building BTU/sf-yr (site)'. This page includes a table with 'User' (LBNL) and 'Organization' (Lawrence Berkeley National Laboratory), and a bar chart comparing 'BTU/sf-yr (site)' and 'Lab Area Ratio' across various facilities.

- **Core information resources**

- Design Guide
- Case Studies
- Energy Benchmarking
- Best Practice Guides
- Technical Bulletins

- **Design process tools**

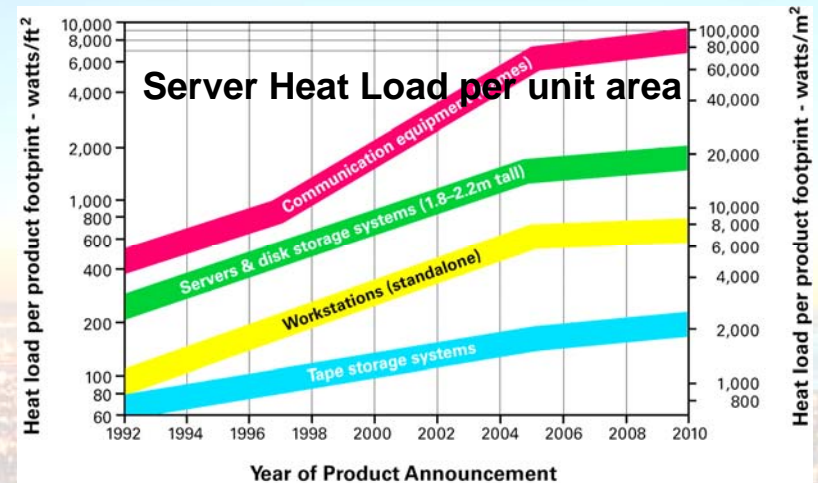
- Env. Performance Criteria
- Design Intent Tool
- Labs21 Process Manual

www.labs21century.gov/toolkit/

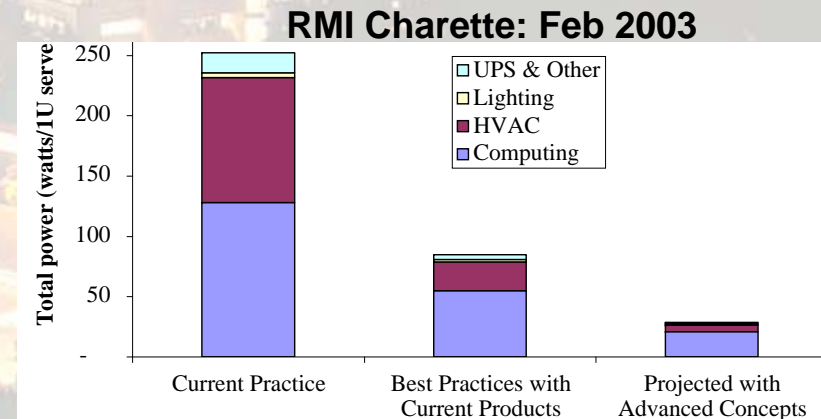
Data Centers: The Opportunity



- Design loads are often significantly higher than actual
- Observed energy intensities vary by a factor of 10 or more
- Power conversion losses are one-third of server load
- Promising Measures
 - ❑ Opportunities range from UPS, to power supply, cabinet design/layout, to facility HVAC choice and sizing, to lighting & envelope improvements

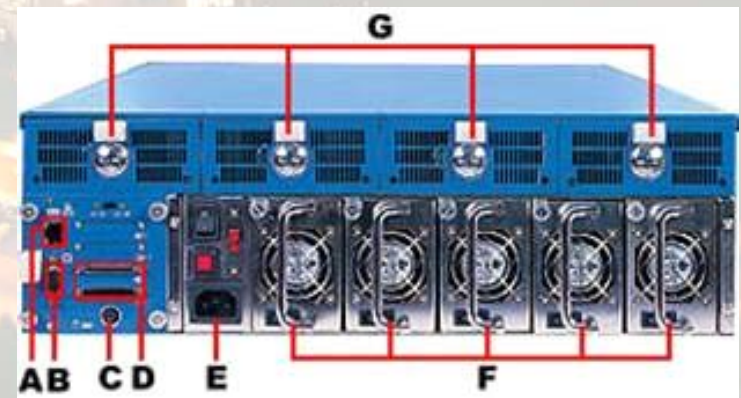


Source: Uptime Institute



Data Center Activities

- **Benchmarking and Best Practices**
- **UPS Efficiency**
- **Power Supply Efficiency**
- **Performance metrics – computing “horsepower” and energy use**
- **Demonstration Projects**
 - Remove heat from servers without fans and at warmer temperatures
 - DC powering
 - Wireless monitoring and control



Summary

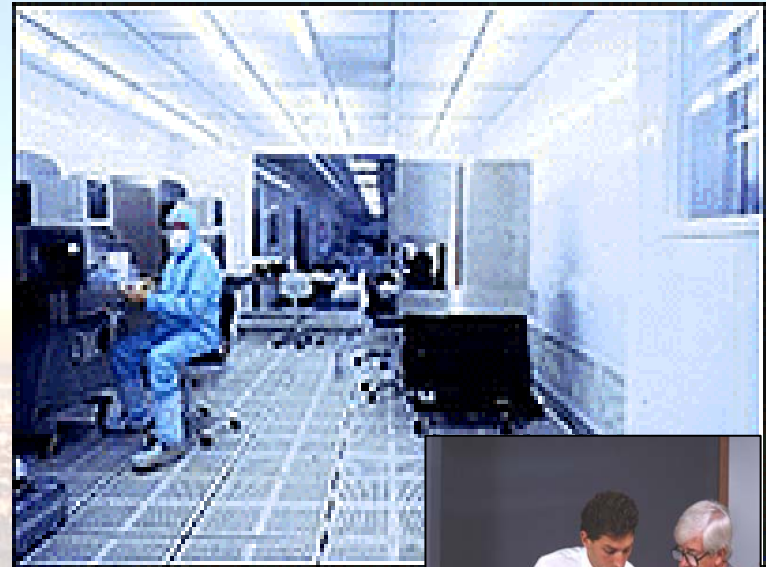


Hi-Tech Industries are important

...growing economic driver in most (all?) states

Cleanrooms/Laboratories/ Data Centers are energy intensive

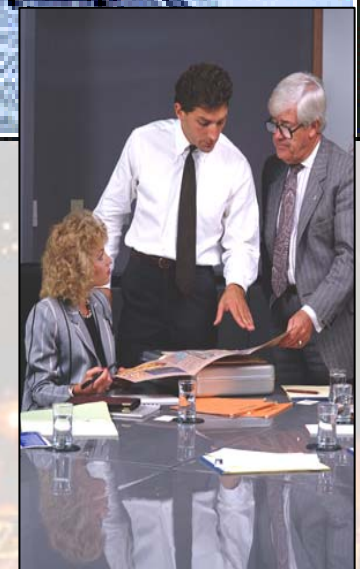
...huge energy savings opportunities



Bridging the “Valley of Death”

Collaboration with CEE Members

- Genesis of program >1995 (CIEE)
- Benchmarking (PG&E)
- Demonstrations (PG&E, SDG&E)
- Training (PG&E, SCE, SMUD, Austin Energy)
- Tool development (PG&E, SCE, Sempra)



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