Lawrence Berkeley National Laboratory Energy Retrofit Program Case Study

Dale Sartor, P.E.

Laboratories for the 21st Century
Cambridge, Massachusetts
September 9, 1999

Lawrence Berkeley National Laboratory
Environmental Energy Technologies Division
Applications Team

Application of the Process:

The Successful Retrofit of the Lawrence Berkeley National Laboratory

The LBNL In-House Energy Management Program

- History
- Staff
- Program elements

Retrofit Projects

New Construction

Program Cost and Impact

Utility Cost Management

Lessons Learned

History

1986: LBNL IHEM formed - dedicated staff

1986-89: Process-related retrofits increased runtime, benefits recognized, management committed to IHEM

1990: Began comprehensive building retrofits

1995: Energy use reduction from FY ’85 peaked at 42%

Electrical rates reduced from $.08 to $.055/KWh

Natural gas rates reduced from $.40 to $.28/therm

1996: Began maintenance engineering services

1997: Electrical rates reduced from $.055 to $.035/KWh

Staff:

Dedicated in-house engineers, and project managers

Scientists borrowed from research division

Consultants

Program Elements:

Energy Efficiency Studies (40+ since 1985)

Energy Efficiency Retrofits (30+)

- Direct funded
- Utility surcharge funded
- Energy Savings Performance Contract

New Construction

- Conceptual Design Report
- Energy Efficiency Report
- Project team participation
- Good retrofit projects

Employee Awareness and Training

Research and Development

A-Team Support to other Federal Agencies

Typical Retrofit Projects

Constant Velocity VAV Fume Hood control

VFD control for fans and pumps

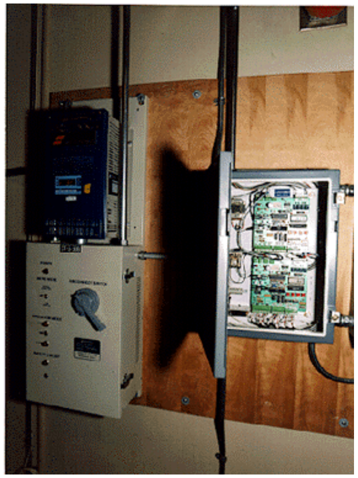
DDC/EMCS (over 8,000 points in place)

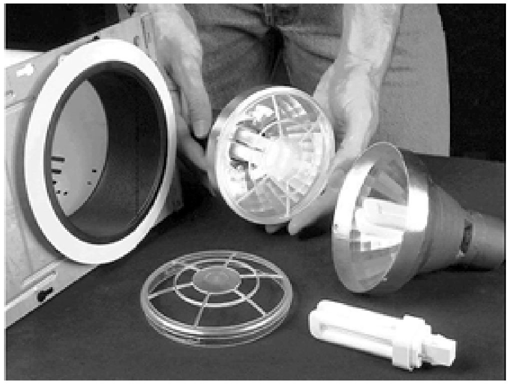
T-8/Electronic Ballast lighting

Occupancy sensor controlled lighting

LED exit signs

CFLs





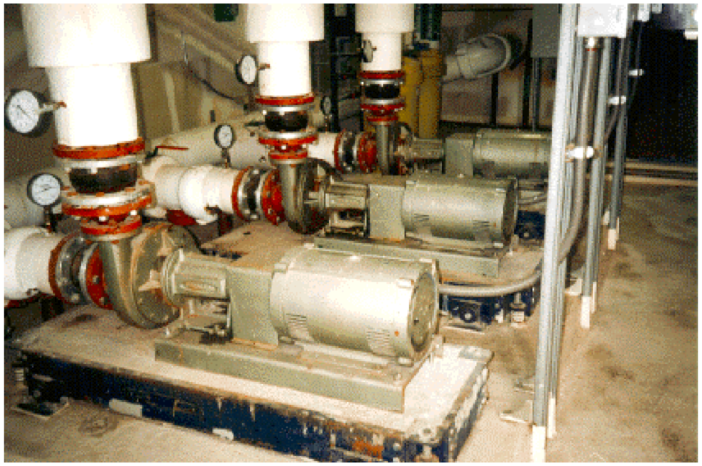
Typical Retrofit Projects - cont.

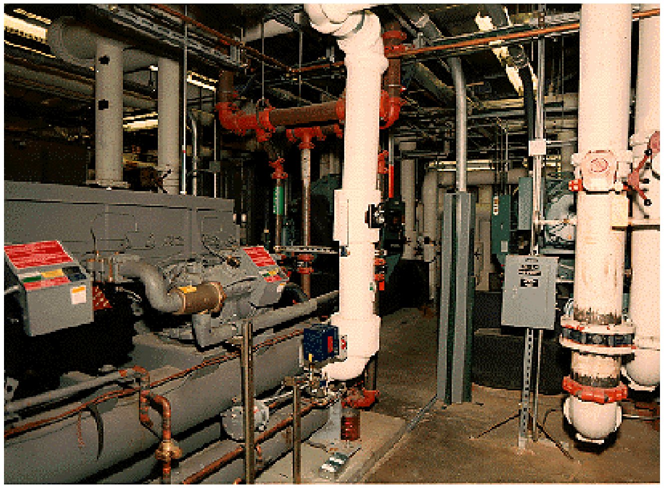
Premium Efficiency Motors

Consolidation of Boiler and Chiller plants

Modular boilers

Small base loaded chillers





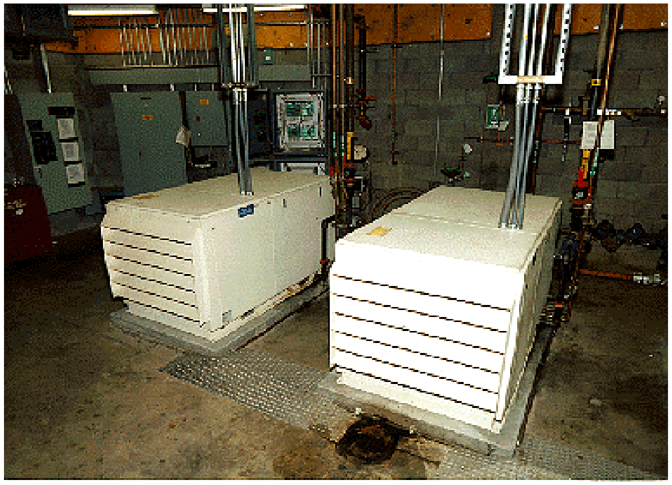
Typical Retrofit Projects - cont.

Mechanical equipment replacements

Waterside economizers

Metering

Process



Instrumented Survey

Uncovers “hidden” opportunities

Improves quantification of savings

Aids in commissioning and persistence

Can save purchase of new unneeded capacity

New Construction

Late design review doesn't work!

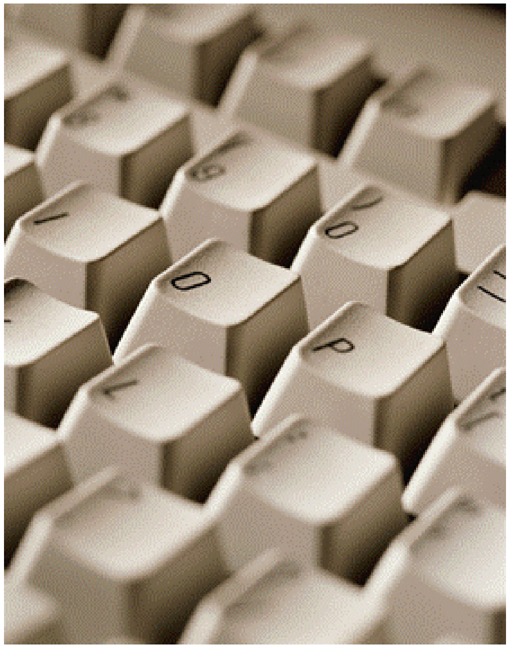
- Design decisions are made
- Appliqué - not a systems approach
- Options easy to analyze
- No big hits
- No budget

Input at Conceptual Design Phase is Critical

Identify key opportunities

Provide direction (priority) to A/E team

Establish budget line-item(s)



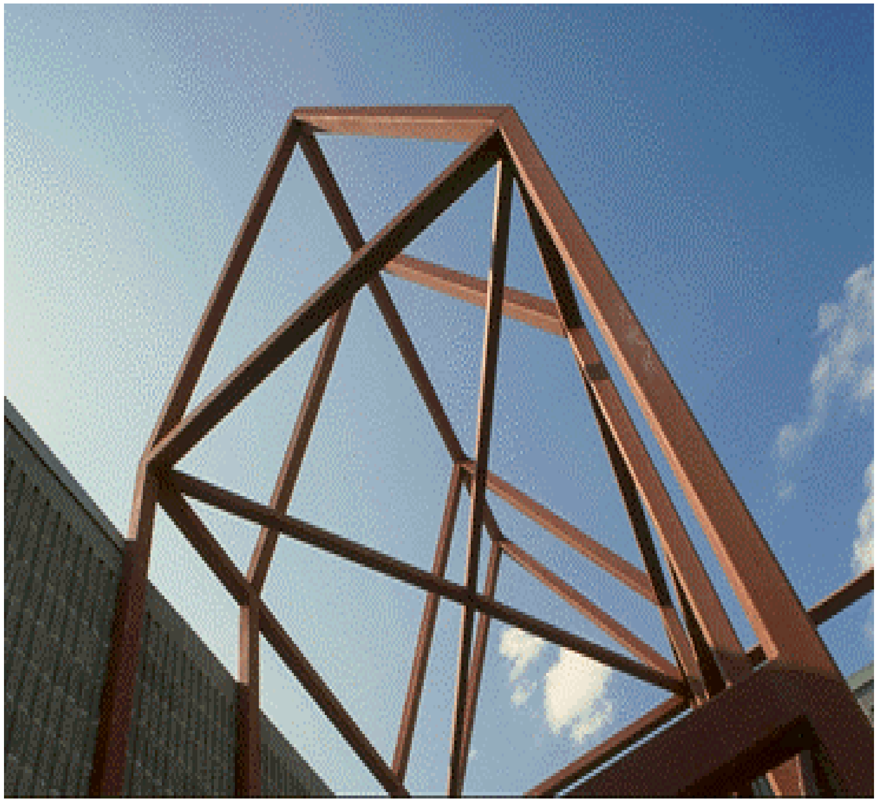
Reduce Load

Focus on the big hits

Energy Efficient Design Process - A Systems Approach

What does it mean

Potential to reduce first cost



Encourage Inter-disciplinary Communication

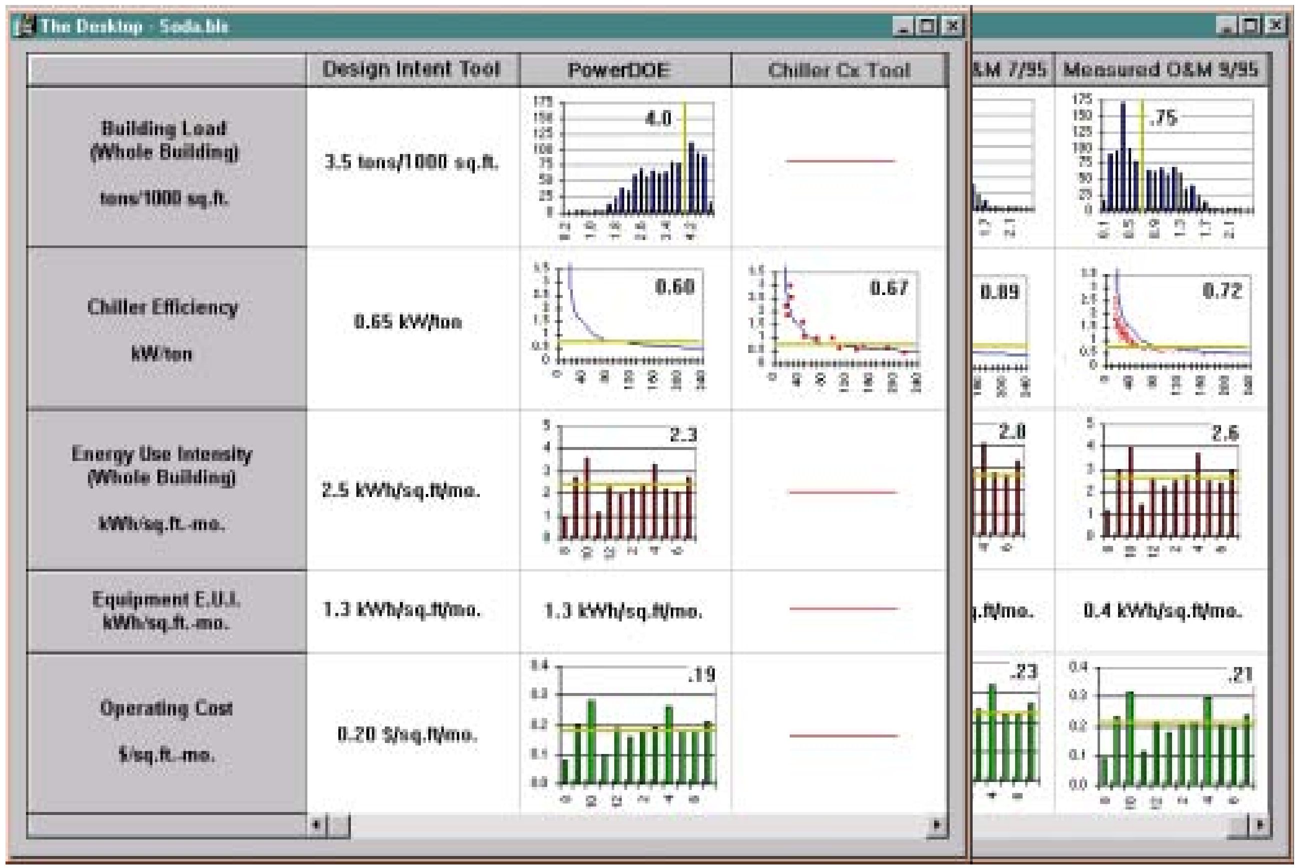
Design Charrette

Regular meetings
(not another one!)

Your ideas

Life Cycle Communications

Building Life Cycle Information Systems



Mitigate Risk

Internal: CHANGE = RISK

External: A/E

- “New” technology risk
- Load assumptions

Goal:

Energy Efficiency is the Base Case!

Opportunities are Real

41% reduction in energy use per square foot from 1985 baseline

$4.4 million/year more research based on 1985 energy prices

Pollution reduction:

- 14,174 tons CO_2
- 12,885 tons SO_2
- 9,449 tons Nox

Improved worker productivity

Safer environment

Improved reliability

Investment Required

Studies: $2.6 million

Retrofit: $20 million

Utility Cost Management

Billing errors (FY96 savings was $98K)

Electricity: WAPA @ $.035/KWh

Natural Gas: Defense Fuel Supply Center
@ $.28/Therm

Overall 40% savings due to rate reduction

Integrated Supply and Demand Side Energy Management

Potential Savings Over 60%

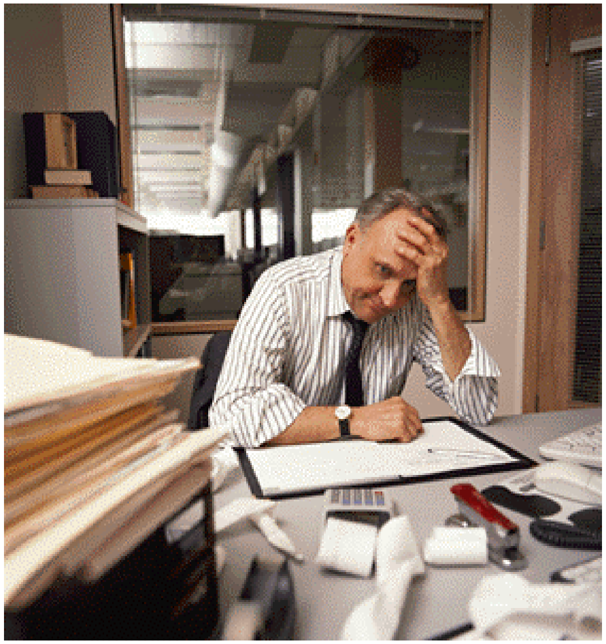
baseline:	$11.0 million
actual:	$ 3.8 million
overall savings	$7.2 million (or 65%)

New Energy Market

Seek utility supply "partners" providing an integrated approach

Beware of one sided proposals

Beware of take-or-pay utility outsourcing



Lessons Learned:

Outside air dominant load - focus on HVAC

Fume hood VAV (constant velocity) safe and efficient

DDC/EMCS to zone

Commissioning and ongoing O&M important

Don’t oversize boilers and chillers - use modular units

Avoid reheat

Technology is improving