Lawrence Berkeley National Laboratory
Energy Retrofit Program
Case Study

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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: \( \text{CHANGE} = \text{RISK} \)

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 CO2
  • 12,885 tons SO2
  • 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