Agenda

I. BEST Center Overview – Pamela Wallace, Director-BEST (Building Efficiency for a Sustainable Tomorrow Center), Laney College, Oakland, CA

II. Workforce Gap in Energy Efficiency – Pamela Wallace

III. Industry Endorsement & Collaboration – Pamela Wallace

IV. DACUM Process Peter Crabtree, Principal Investigator, BEST Center & Dean, Career Technical Education-Laney College, Oakland, CA

IV. Skills Gap Analysis & Curriculum Development – Peter Crabtree

V. Defining the Skills of Technicians in High Performance Buildings: An Energy Manager’s Perspective – Chuck Frost, Co-PI, BEST Center, former UC Berkeley Energy Manager & Faculty - Laney College

VI. Small Group Exercise – Exploring what can be done on our own college campus to reduce energy consumption
BEST Center Overview

GOALS:

• Expand the capacity of community colleges to provide building technician education

• Engage industry to support building education programs

• Expand the STEM pipeline for students coming into building science professions

BESTctr.org
BEST Center College Network

Colleges with commercial HVAC, energy management, and/or building automation programs

Map of BEST Center College Network
(66 members)
Collaboration - High Performance Building Operations Professional Training (HPBOP)
## Industry Advisory Councils

### ADVISORY COUNCIL COMPANY REPRESENTATION

<table>
<thead>
<tr>
<th>BROAD REPRESENTATION</th>
<th>National Advisory Council</th>
<th>California Statewide Stakeholder Council</th>
<th>Silicon Valley Working Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oracle</td>
<td>ABM Engineering</td>
<td>League of California Cities</td>
<td>C &amp; W Services</td>
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<tr>
<td>Pacific Northwest National Laboratory</td>
<td>Labor Union 501</td>
<td>Healthy Buildings</td>
<td>Impec Group</td>
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<tr>
<td>Facility Engineering Associates</td>
<td>California State Chancellor’s Office</td>
<td>Therma</td>
<td>Enovity</td>
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<tr>
<td>International Facility Management Association (IFMA)</td>
<td>CBRE</td>
<td>Shorenstein</td>
<td>Western Allied Mechanical</td>
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<tr>
<td>JLL (Jones Lang LaSalle)</td>
<td>U.S. General Services Administration (GSA)</td>
<td>Boston Properties</td>
<td>GSH Group</td>
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<tr>
<td>CEES-Advisors</td>
<td>U.S. General Services Administration (GSA)</td>
<td>State of California Department of General Services (DGS)</td>
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<tr>
<td>BOMA Energy Chair</td>
<td>Office of Federal High Performance Green Buildings</td>
<td>CSU Maritime Academy</td>
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<tr>
<td>CBRE (CB Richard Ellis)</td>
<td>Sheraton Hotel</td>
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</table>
Workforce Gap in Energy Efficiency Sector


Building Operations Professionals includes: HVAC Mechanics and Installers, General Maintenance and Repair Workers and Stationary Engineers, Boiler Operators and Property/Real Estate Professionals

Key Findings:

• 11.5% Building Operations Professional Growth between 2013-2018

  ➢ 741,831 total job openings between 2013-2018

  ➢ 64% are expected to retire in 20 years
January 2017

77% Construction/installation firms report hiring difficulty over the past 12 months

Reasons it’s difficult to find qualified applicants:
• 43% said due to lack of experience, training, or technical skills
• 33% said due to insufficient qualifications, certifications, or education

Constructions firms encountered difficulties finding the following workers:
• 30% installation workers
• 26% technicians or technical support
• 25% electricians or general construction workers
Category One: buildings whose operational characteristics tend to have tight controls on variables such as temperature, humidity, CO2, dust, or biological contaminants including museums, research laboratories, high tech manufacturing sites, hospitals, data centers, food manufacturing, and Class A commercial buildings. These may or may not be efficiently operated.

Category Two: ASRAE Guideline 32-2012 defines HPB as “a building that consistently delivers a highly productive environment without wasting resources.”
HPBOP Training & Certification

Mission: Improve the skills of the technical workforce to manage commercial buildings to a high performance standard, effectively and sustainably.

Goals:
- Develop and refine short term HPBOP training for incumbent building technicians
- Develop a national ISO certification for HPBOP
- Develop guidelines for a 2-year AS degree curriculum aligned with the national certification
A Theory of Knowledge Hierarchy*

(1) Factual knowledge – understanding the characteristics of an object or component

(2) Procedural knowledge – understanding how to carry out a procedure

(3) Conceptual knowledge – knowing principles, categories, models, theories

(4) Strategic knowledge – knowing how to devise a plan or method or how to manage complex processes

*”Advances in Specifying What Is to Be Learned.” Richard E. Mayer, in Development of Professional Expertise, 2009
Knowledge Hierarchy in Instructional Practice for Building Technicians

(1) Factual knowledge – Mechanical and electrical systems, building science, energy literacy, information technology

(2) Procedural knowledge – routine maintenance, preventative maintenance, ASHRAE Standard 180

(3) Conceptual knowledge – Retro-commissioning, Building Automation Systems, Buildings as Systems

(4) Strategic knowledge – Continuous quality improvement, energy conservation, predictive maintenance
# DACUM Research Chart for High Performance Building Operations Professional

<table>
<thead>
<tr>
<th>DUTIES</th>
<th>TASKS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Analyze Building Operations</td>
<td>A.1 Review building documentation (e.g., SOPs, DMS, MEP)</td>
</tr>
<tr>
<td></td>
<td>A.10 Trend building occupancy/production</td>
</tr>
<tr>
<td>B. Maintain Building Operating Efficiency</td>
<td>B.1 Identify BAS discrepancies</td>
</tr>
<tr>
<td></td>
<td>B.10 Review VFD settings</td>
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<tr>
<td></td>
<td>B.11 Manage preventive maintenance plan</td>
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<td></td>
<td>B.12 Manage predictive maintenance plan</td>
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<tr>
<td></td>
<td>B.13 Optimize equipment operating schedules</td>
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<td>B.14 Optimize operating set points</td>
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<td></td>
<td>B.15 Reviewing key performance indicators (e.g., reset schedule, HVAC, B.5 peak load)</td>
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<tr>
<td></td>
<td>B.16 Conduct regular building performance meetings</td>
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<td></td>
<td>B.5 Optimize pump performance</td>
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<tr>
<td>C. Audit Building Operational Performance*</td>
<td>C.1 Review maintenance and repair log</td>
</tr>
<tr>
<td></td>
<td>C.10 Perform lighting audit</td>
</tr>
<tr>
<td></td>
<td>C.11 Perform indoor air quality audit</td>
</tr>
<tr>
<td></td>
<td>C.12 Audit equipment sequence of operations</td>
</tr>
<tr>
<td></td>
<td>C.13 Audit building equipment operating procedures</td>
</tr>
<tr>
<td></td>
<td>C.14 Review building occupant survey results</td>
</tr>
<tr>
<td></td>
<td>C.15 Test combustion equipment efficiencies</td>
</tr>
<tr>
<td></td>
<td>C.16 Perform water treatment audit</td>
</tr>
<tr>
<td></td>
<td>C.17 Perform waste audit (e.g., hazardous, landfill, recycling)</td>
</tr>
<tr>
<td></td>
<td>C.18 Determine need for energy consultant</td>
</tr>
<tr>
<td>D. Create High Performance Building Plans</td>
<td>D.1 Obtain payback analysis</td>
</tr>
<tr>
<td></td>
<td>D.10 Optimize equipment sequence of operations</td>
</tr>
<tr>
<td></td>
<td>D.11 Develop operational &amp; performance metrics</td>
</tr>
<tr>
<td></td>
<td>D.12 Identify utility rebates</td>
</tr>
<tr>
<td></td>
<td>D.13 Develop commissioning plan</td>
</tr>
<tr>
<td></td>
<td>D.14 Develop building occupancy policy</td>
</tr>
<tr>
<td></td>
<td>D.15 Identify alternative energy opportunities</td>
</tr>
<tr>
<td></td>
<td>D.16 Develop zero net energy plan</td>
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<tr>
<td></td>
<td>D.17 Develop control system plan (e.g., enhanced data points, trends, data analysis)</td>
</tr>
<tr>
<td></td>
<td>D.18 Develop system integration plan</td>
</tr>
</tbody>
</table>

* Audit reports include recommendations for improvement.

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April 7-8, 2016

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[NSF Logo]  
Best  
Building Efficiency for a Sustainable Tomorrow
# DACUM Research Chart for High Performance Building Operations Professional

**April 7-8, 2016**

<table>
<thead>
<tr>
<th>DUTIES</th>
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</thead>
<tbody>
<tr>
<td><strong>E. Implement Continuous Improvement</strong></td>
<td>E.1 Present facility improvement plan to management</td>
</tr>
<tr>
<td>E.10 Implement zero net energy plan</td>
<td>E.11 Implement system integration plan</td>
</tr>
<tr>
<td><strong>F. Manage Building Systems</strong></td>
<td>F.1 Track utility costs &amp; consumption</td>
</tr>
<tr>
<td><strong>G. Perform Administrative Tasks</strong></td>
<td>G.1 Review test equipment and tools</td>
</tr>
<tr>
<td>G.10 Assess vendor's high performance qualifications</td>
<td><strong>H. Participate in Professional Development Activities</strong></td>
</tr>
<tr>
<td>H.10 Participate in conferences and trade shows</td>
<td>H.11 Participate in code update training (e.g., energy efficiency, building codes, local ordinances)</td>
</tr>
</tbody>
</table>
National Validation Survey Results

1. 8 Duties and 116 Tasks Identified via DACUM
2. Validation Survey sent to BOMA
3. Survey Responses Received - 256
4. Number required for valid response 100
5. Geographic Distribution
6. East 31
   West 65
   North 82
   South 23
   National 8

Excellent Response Rate & Geographic Distribution
1. Personnel functions excused
2. Core processes added
3. Core skills needed to be addressed (e.g.)
   1. IT skills
   2. Energy Literacy
DEFINING CQM

1. “Commercial Quality Maintenance” or CQM not well defined
2. Multiple sources combined
   1. Other DACUM’s and JTA’s
   2. Other Curricula Outcomes
   3. Industry recognized documents (ASHRAE)
DETERMINING THE SKILLS GAP

1. HPBOP <-> CQM lists compared
2. Unique HPBOP Tasks selected
3. Unique Tasks clustered into course subject areas
4. Foundation skills included
COURSE DEVELOPMENT

9 COURSES/CONTENT AREAS

INFORMATION TECHNOLOGY
ENERGY LITERACY
BUILDING SYSTEMS

SYSTEMS ANALYTICS
SYSTEMS MANUAL
BUILDING AUTOMATION

ENERGY CONSERVATION
COMMISSIONING
CONTINUOUS IMPROVEMENT

LANEY COLLEGE

NSF

BEST
Building Efficiency for a Sustainable Tomorrow
1. Course Materials
   1. Lesson Plan each course
   2. Module Plans (>75)
   3. PowerPoints, Lecture Materials
   4. Handouts
   5. Exercises

2. Use of available methods
   1. Core standards
   2. Standard resources
   3. Emphasis on Exercises
Next Steps

- Complete train-the-trainer package for short term incumbent worker training
- Coordinate additional pilot training in California
- Begin work on a national ISO certification process for HPBOP
- Develop curriculum guidelines for 2-year technician education aligned with national certification
Defining the Skills of Technicians in High Performance Buildings: An Energy Manager’s Perspective

Chuck Frost, Former UC Berkeley, Energy Manager
Co-Principal Investigator & Faculty-Laney College, Faculty
We will permanently reduce the amount of energy the campus uses while empowering faculty, staff, and students to take energy savings steps that reduce our environmental footprint and save money.
UC Berkeley Energy Office

**Oversee** many of the new initiatives and services

Support **ongoing commissioning** (or “tune-ups”) of buildings

Work with Facility Managers and building occupants to speed energy-related repairs, **identify conservation measures and reduction projects**, reinforce Unit initiatives

Provide **dedicated support** for energy-related maintenance

**Analyze building energy use data**, and share monthly data with Units
Energy Office Staffing

- Energy Manager
- Energy Engineer
- Energy Analysts
- Mechanical Engineer
- Architect
- Stationary Engineers
- Electrician
- HVAC/ Steam Fitter
Building Operations Professional

Manages the maintenance and operation of building systems and installed equipment, and performs general building maintenance to optimize performance, maintain the building’s operability and ensure the comfort and safety of building occupants.
High Performance Buildings create operational challenges

- Increased operational cost for maintenance budgets
- More complex control strategies and sophisticated equipment
- Integration of building systems
- New technologies such as wireless, variable refrigerant flow
- Shortages in highly skilled building operators
Skills needed for High Performance Building Professionals

- Strong analytical skills, e.g. trend data analysis
- Ability to utilize a systems or holistic approach to equipment checks and troubleshooting
- Ability to evaluate facility conditions
- Strong understanding of control systems as well as advanced sequences of operation and system integration
- Interpersonal communications skills and teamwork
- Computer skills
- Be able to measure and verify savings
What happened here?
Incentive Program: Overview

Provide **financial incentives** to Operating Units (OUs) to reduce user-controlled electrical consumption.

**Create electricity consumption baselines** based on historical data

OUs that **reduce electricity use receive an incentive payment**; later, OUs that exceed baseline pay overage charge

**Share monthly data** on electricity use by Unit

**Install software & building kiosks**, providing access to performance information
Welcome to the energy dashboard at UC Berkeley! This dashboard is part of UC Berkeley’s Energy Management program, a comprehensive program aimed at permanently reducing the amount of energy the campus uses. It empowers faculty, staff, and students to take smart, simple energy savings measures that will improve our environmental footprint and save the campus money returning those funds to teaching and research. Learn more at myPower.berkeley.edu

How is it used?

The dashboard lets you see the real-time effects of your energy savings measures such as turning off the lights at night, lowering the heat by a degree, or other similar actions. You will be able to see the cumulative impact of your behavior and of others in your building, proving that small actions can add up to a large impact. Everyone has a role in the campus energy conservation effort.

How does it work?
Energy savings and persistence for new and retro-commissioned buildings

- Equipment Scheduling
- Simultaneous heating and cooling
- Outside air usage
- Sensor error
- Equipment put in hand
- Set point adjusted
- Reset schedules modified
- Control sequence modified
- Calibration of pneumatic
- Occupant comfort & productivity
ECM Small Group Exercise

- What can you do?

- Break into small groups to identify key issues that are preventing you from advancing energy efficiency. (20 minutes)

- Designate a spokes person who will share some of the ideas that the group identified with the large group. (15 minutes)
Presenters

Peter Crabtree, PI, BEST Center Dean, Career Technical Education-Laney College; pcrabtree@peralta.edu; 510-464-3218

Chuck Frost, Co-Principal Investigator- BEST Center & Faculty - Laney College, Oakland, CA; cfrost@peralta.edu 510-464-3292

Pamela Wallace, BEST Center Director- Laney College pwallace@peralta.edu; 510-464-3248

Contact us at: BESTCTR.org

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