Panelists

- Data-Driven Energy Efficiency – Hilary Ego
- Butte College Campus-wide MBCx – Ken Albright
- Cerritos College: Integrated Energy Master Plan – David El-Fattal
Data-Driven Energy Efficiency

Hilary Ego
June 29, 2015
California Higher Education Sustainability Conference
Background

College of San Mateo

Cañada College

Skyline College
Problem

- Manage multiple buildings on multiple campuses
- Building data
- Outdated and aging infrastructure
- Shifting workforce
- Maintenance
- Energy efficiency
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<tr>
<th>Major Components</th>
<th>Purpose</th>
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<td>Building management system</td>
<td>Improve energy performance</td>
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<tr>
<td>Energy monitoring</td>
<td>Enhance learning environment</td>
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<td>Building analytics</td>
<td>Reactive to proactive maintenance</td>
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FACILITIES PLANNING MAINTENANCE AND OPERATIONS
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FACILITIES PLANNING MAINTENANCE AND OPERATIONS
Communication
Next Steps

- Two campuses complete
- Final campus to be completed in August
- Training for engineering staff
Suggestions for Replicability

- Communication and collaboration
- Kick-off meetings between partners
- Training
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Innovative Energy Practices within the California Community College System
Butte College
Campus-wide MBCx
(aka Metering Project – shhh)

Ken Albright, MBA, CEFP
Prop 39 Doesn’t Like Meters

• Meters, by themselves, cannot save energy (true)
• Managing energy consumption at the building level is not efficient without meters and data loggers (also true)
• Monitoring Based Commissioning (MBCx) is OK with Prop 39 (sorta)(still?)
• If an MBCx project can install meters and still achieve the Savings to Investment Ratio (SIR) it’s OK
• Ergo: we found the SIR needed to install meters campus-wide
Scope

• Install meters
  • Total inhabited buildings – 32 (one not included)
    • Already had bldg level energy metering – 2 LEED, 1 stand alone, 2 electricity only metered
  • New meters installed
    • 27 electricity
    • 25 natural gas (all building don’t have gas)
    • No other energy inputs
    • All connected to BAS to collect and record data

• Collect “before” data
• Retrocommissioning
• Collect “after” data
Costs

• Meter installation
  • Electricity - $99k
  • Natural gas - $76k
• Connection to BAS - $125.5k
• Retrocommissioning programming - $63.7k
• Commissioning agent - $25.7k
• Total - $389.9k

Funding

• Prop 39 - $303k
• PG&E Incentive - $118k
• Total - $421k
Retrocommissioning

• Working on only 8 buildings
  • Total in project = 255,841 OGSF
  • District = 785,717 OGSF
  • ~33% of space
  • Some of our biggest consumers of energy
    • How did we know that?
  • Low hanging fruit

• Projected 1 year savings - $40,873
  • 15 year NPV = $596,754
  • Sir = 1.4
Measurement & Verification

• In progress now
  • Middle of summer not ideal for MBCx data collection
  • Will extend into fall
  • Confident we’ll have more than enough savings
    • Finding lots of problems to fix
The Moral of the Story

• It IS possible to have a metering project
• You just have to call it an MBCx project
Innovative Energy Practices within the California Community College System
Quick Facts

• Founded in 1955
• 18,000+ students (FTES)
• 135 acres
• 41 buildings, 1 million gsf
• $560 million for modernization and new construction
• $115 million operating budget
• $2.1 million annual cost of energy
Green Cerritos College Environmental Stewardship

Sustainability Initiatives

- Board Policy 3580 – Environmental Sustainability
- Cerritos College Sustainability Plan
- Greenhouse Gas Reductions
- Energy Savings
- Water Conservation
- Green Education
- USGBC’s LEED standard for projects above $5 million
- CCC/IOU Partnership first-of-a-kind Integrated Energy Master Plan
Project Approach

- Create a comprehensive plan of holistic energy solutions
- Align with present state and future condition of campus
- Dual integration: intra-campus and with California’s guiding energy policies
- Real-world solutions using a wide spectrum of applications
- A strategic roadmap for other institutions
Challenges

- Facilities master plan – IEMP overlay
- One meter – over 40 major buildings
- One gas meter
- Sub meters do not isolate the different load cooling load, lighting loads, plug loads and heating.
- Data gathered over 3 years to be effective
- Installation of permanent sub-meters time consuming
- Electric circuits will need to be modified
- Temporary meters when installed are for a few months only
What do we know

• Facilities master plan and phasing
• Spatial mapping – window, walls, footprint, etc
• Age of each building – Codes determine performance and construction
• Climate files – cooling and heating loads
• Light fixtures – lighting consumption
• Types of mechanical systems – central plant, roof top packaged system, VRF systems, etc
• Energy Upgrades will effect IEMP
Data Analytics

• Regression methods in predicting the accuracy of software.
• ASHRAE recommendation of consumption in sq ft
• CBECs method for consumption
• Utility Data for electricity gas and water
• Utility bill alignment – 15 minute data for 3 years
• Calibration
Methodology

Data Collection
- Factor selection
- Regression
- Results Analysis
- Tool Development
- Verification

Workflow

Input
- EUI (BEopt)
- \( P_0 \)
- Architecture Features: \( A_0, A_1, A_2, \ldots \)

Data Base
- Regression
- PredictTool

Output
- EUI
- HEED
- eQuest
- IES-VE
- IES-Ware
- EnergyPro
- DesignBuilder

Tools:
- BEopt - Shortcut
- DesignBuilder
- EnergyPro 6
- eQUEST 3-65
- HEED
- IESVE 2014
- Minitab 17
Fitted Regression Model----Stepwise

Response: EUI (HEED), EUI(eQuest), etc.
Predictor: EUI (BEopt), A1-A9, B1- B3
Stepwise: $\alpha = 0.15$
Existing Energy Consumption By Building
INTEGRATED ENERGY MASTER PLAN / CERRITOS COLLEGE

The chart provides a visualization of energy consumption and provides a quick comparison to show that there is an immediate need for energy efficiency measures that fall into the category of large consumers that are not slated for either demolition nor major renovation as these have the largest impact on savings for the college.
Existing Energy Consumption By Building
Comparison of Cerritos College EUI, CBECs and Goal EUI
Green House Gas Emissions

Cerritos College GHG emissions in 2013

- Mobile emissions (scope 1): 67 metric tonnes
- Stationary emissions (scope 1): 2026 metric tonnes
- Indirect emissions (scope 2): 3837 metric tonnes
- Total emissions (scope 1 & 2): 5930 metric tonnes
Summary of Recommendations

• Apply Energy Design Guidelines for all new building design and construction
• Conduct ASHRAE Level II and I energy audits
• Continue to identify and implement energy efficiency and conservation measures
• Participate in cost beneficial Demand Response Program
• Assess and implement site specific renewable energy alternatives
Conclusion

• Road map: An integrated energy master plan overlay to facilities master plan
• Benchmarking the entire campus
• Help manage energy and energy costs, short-, medium- and long-term
• Reduction in operational costs to better utilize funds for other initiatives
• Funding opportunities: utility rebates, Prop 39, bond funds
Contact

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Innovative Energy Practices within the California Community College System