Energy Modeling with eQUEST

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Benefits to Energy Modeling

- Catalog site energy spend per building benchmark to global networks
- Utilize for ongoing commissioning efforts (OCx)
- Target specific Energy Conservation Measures (ECMs) with best return on investment
- Quickly develop detailed energy saving numbers
- Get “buy-in” from investors on capital projects
- Incorporate savings +/- % ranges for financial analysis
- Create living record of building systems and operations

The models can be re-used again and again
Case Study – Campus Modeling
## Facility Descriptions

<table>
<thead>
<tr>
<th>BLDG. #</th>
<th>TYPE</th>
<th>AREA (SF)</th>
<th>HVAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>8201</td>
<td>Warehouse / Data Center</td>
<td>10,500</td>
<td>Unit Heaters, CRACs</td>
</tr>
<tr>
<td>8200</td>
<td>Mixed-use Offices / Labs</td>
<td>30,000</td>
<td>VAV / CAV, CHW / HW</td>
</tr>
<tr>
<td>8900</td>
<td>Modular Offices</td>
<td>8,000</td>
<td>Heat Pumps</td>
</tr>
<tr>
<td>8100</td>
<td>Main Manufacturing</td>
<td>156,000</td>
<td>VAV, CHW / HW</td>
</tr>
<tr>
<td>8400</td>
<td>Utility Building</td>
<td>24,000</td>
<td>Unit Heater</td>
</tr>
<tr>
<td>8700</td>
<td>New Manufacturing</td>
<td>400,000</td>
<td>VAV, CHW / HW</td>
</tr>
</tbody>
</table>
Modeling Process

1) Previous Model, 8201 was obtained from prior year (EMA)
2) Second model, 8200 / 8900 was built & obtained from EMA
3) Third model, 8400 / 8100 was built by CRB
4) Fourth model, 8700 was built by CRB (started by client)
5) All models were prepped to be combined
   a. Unique names applied to circulation loops, systems and other parameters
   b. Naming convention updated to be unique (floors, spaces, zones)
   c. Coordinate parameters were created for locating buildings
6) Campus model was created and calibrated to site utility bills
Some Notes on Calibration, M&V

General
- Metering and sub-metering allows for better diagnostics
- Can directly monitor operational improvements
- Metering can link up to energy models

Case Study Example
- Data points recorded every 30 minutes
- All of process / HVAC steam metered (several meters)
- Process / HVAC CHW metered separately
- All chillers metered, including electric usage and load
- All electric usage metered (several meters)

Metering was invaluable for model calibration
8200 & 8900 Electric Calibration
8200 & 8900 Gas Calibration

- Blue line: Metered Gas (Therms)
- Red line: eQUEST Model Gas (Therms)
8100 Initial Electric Calibration

![Graph showing metered and modeled electric data over months.]
8100 Initial Steam Calibration
8100 Final Calibration

- Chiller performance curves were obtained from TRANE
- Chiller sequencing and load management controls were built into the energy model to resemble operation
- Boilers were split to serve primarily HVAC loads
- Steam generators were split to serve process loads
- Additional controls modeled on air handling systems
8100 Final Electric Calibration

- Metered Electric (MWh)
- eQUEST Modeled Electric (MWh)

Graph showing the comparison between metered and modeled electric usage from January to December.
8100 Final Steam Calibration

[Line graph showing the comparison of Metered Steam (Therms) and eQUEST Modeled Steam (Therms) from January to December.]
Campus Electric Usage Calibration

→ 1.8% error
Campus Gas Usage Calibration

→ 6.5% error
Keys to Success

1) Collaborating between building owners and consultants
2) Encouraging transparency with models and calculations
3) Working to link M&V and Modeling where possible
4) Creating models that are **living documents**
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