Energy Models 101 for Building Owners, Managers, and Tenants

September 8, 2015
3:00-4:00 PM EDT
Overview and Agenda

- Welcome and Overview
- National Renewable Energy Lab
- District of Columbia
- Department of Energy
- Question & Answer Session
## Today’s Presenters

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<tr>
<td>Kristin Field</td>
<td>National Renewable Energy Lab</td>
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<td>Mark Chambers</td>
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<td>Amir Roth</td>
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Kristin Field

National Renewable Energy Lab
What is BEM?

- BEM = Building Energy Modeling: software calculation of building energy consumption from description of physical building, occupancy, operations, and weather

MOST WHOLE-BUILDING SIMULATION ANALYSIS INCLUDES:

- Typical weather data representing the site
- Building geometry, floor plan, construction materials, components, and systems
- Building divided into effective thermal zones
- Variations in occupancy, lighting, power loads, and set points and equipment operation by day, week, and season
- Instantaneous and delayed heat transfer
- Energy use of equipment and end uses
- Overall building energy use and costs
Benefits of BEM

• Deeper understanding of building stock
  o Energy and water consumption, peak demand

• Greater ability to identify energy saving opportunities
  o Customize measure packages to the building, location & occupancy
  o *Quantitatively* optimize operational savings, ROI, NPV, etc.

• Demonstration of
  o Compliance with code
  o Performance-level for green certification
  o Qualification for incentives and rebates

• A more energy-efficient, cost-effective building
The Earlier The Better

• **Start with BEM early, before major decisions have been made**
  o BEM will help avoid mistakes that are difficult to overcome later
  o BEM will produce a better-performing, more cost-effective project

![RIGHT STEPS IN THE RIGHT ORDER](image)

- (1) Define Needs
- (2) Identify Appropriate Measures
- (3) Reduce Loads
- (4) Select Appropriate & Efficient Technology
- (5) Plan System Layouts
- (6) Optimize Operation
- (7) Seek Synergies
- (8) Explore Alternative Power

Source: RMI
So You Want To Get Started With BEM ...

- What modeling services exist? Which do I want?
- How do I tell if a modeler is good?
- Should I ask for a particular modeling software?
- What goes into a modeling contract?
... Read This First

• BEM Guide for Owners and Manager
  o Developed in 2013 by RMI, NREL & DOE
  o Distributed to trade groups, owners, corporations, and investors
What’s Inside?

• BEM overview

• Modeling services typically offered
  o Roles and scopes
  o Timelines
  o Software

• Contracting modeling services
  o Types of contracts
  o Modeler credentials
  o Soliciting and contracting modeling services
Choosing a Modeler

• Modeler affiliation is an important factor
  o Specialized consulting firm
  o Project architect
  o Project mechanical engineer
  o Other

• Look for modeler credentials
  o ASHRAE BEMP and/or AEE BESA credential
  o Project experience
  o Firm dedication to quality assurance

• Do you prefer particular software? Does modeler know it?
Soliciting BEM Services

• Type of contract may impact team’s motivation and ability to meet performance targets
  o Design-build
  o Design-bid-build
  o Construction management at-risk
  o Integrated project delivery

• BEM Guide Provides Templates
  o Items to communicate to proposers
  o Items to look for in evaluating bids
  o Example RFP (Request for Proposals)

Credit: RMI/NREL/DOE, Owners’ Guide to BEM
Where Do I Get This?

http://www.rmi.org/Knowledge-Center/Library/2013-17_BEMFOANDM

• Questions?
  o Kristin Field (kristin.field@nrel.gov)
Mark Chambers

District of Columbia

Energy Modeling in the District

Mark Chambers
DC Department of General Services
Director of Sustainability & Energy
Energy Modeling for Project Targeting

- Comparing modeled performance to actual performance; Stoddert example:
  - Site was not performing to design intent
  - DGS ran a retrocommissioning project
  - Now the site performs as modeled
  - Substantial cumulative savings form RCx

- Energy models support PPA financing
  - Pilot sewage-based heat exchange system
  - Economic pro forma hinges on model
Predictive HVAC Optimization

- DOE Building Technologies Office grant
- Deployment for 3M Ft²
- Building IQ system draws on open BAS data
- Builds thermal and energy performance model
- Fine tunes airside HVAC systems
- Responds to PJM pricing
- Delivers comfortable conditions with minimal cost
Automated M&V Analysis

• LBNL study on whole building performance modeling based solely on interval data
• Ten models tested
• DGS provided 44% of data

• Conclusions
  – Differences between models are mostly small Average median percent error ~1.2%
  – No clear “winner” across models
  – All are good, especially with 12 months training

Results of 10 models
Commitment to Leadership

$75,000,000 spent on energy, annually

360,000 tons of CO$_2$ emitted every year by buildings

10% drop in kWh since BuildSmart DC launched
Thank You.

Feel free to follow up with me @GrowACity or Mark.Chambers@dc.gov
Energy Modeling using DOE’s Tools Ecosystem

http://energy.gov/eere/buildings/building-energy-modeling/

Sep. 8, 2015
Amir Roth, Ph.D.
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Ins and Outs of Building Energy Modeling

Ins: information about your building
• Assets: geometry, constructions, systems
• Operations: occupancy, internal loads, setpoints
• Weather
• Consumption data (if you have it)
• Detail helps but isn’t necessary

Outs: analytical view of your building
• Where are when do kWh (& money) go?
• Where are savings opportunities?
• Can I improve occupant comfort?
• How far above or below is it from code?
• Does it qualify for certificates or incentives?
• Even if your building doesn’t exist yet!

Any BEM >> no BEM, but if you’re going to BEM ...
... Ask for an EnergyPlus™ Model (and Modeler)!

Why? Advanced capabilities
- Low-energy designs & systems
- Thermal & visual comfort & IEQ
- Flexible HVAC configurations (e.g., VRF) & controls
- DOE backing ➔ continuous improvement

Why? Open-source licensing
- Know what you’re getting & avoid lock-in

Why? Growing user & tool ecosystem
- 27,000+ downloads per version
- DesignBuilder, Sefaira, OpenStudio

More at energyplus.net
DOE’s BEM Ecosystem = EnergyPlus engine ...

OpenStudio middleware/SDK/platform

- Common core functions
- Large-scale analysis support via cloud

More at openstudio.net

→ inter-operable apps

- Design & retrofit
- Auditing
- Code compliance
- Project management
- Portfolio management
- Inter-operable
- Commercial or open-source
- New app every couple of months ...
  ... many from utilities!!
Parametric Analysis Tool

OpenStudio supports “measures” – scripts that operate on models

- Can be simple search & replace
- Or surgical & sophisticated
- ECMs or QA or reporting
- Automation, automation, automation
- bcl.nrel.gov/nrel/types/measure/

PAT: select measures

Packages sorted by EUI, ROI, etc.

nrel.github.io/OpenStudio-user-documentation/reference/parametric_studies/
Portfolio Management Tools – EDAPT and COFFEE

Energy Design Assistance Project Tracker (eda-pt.org)

- Project QA/QC, reporting & rollups
- New construction & retrofit workflows
- “Bought back” and “opened up” by DOE

COFFEE nationalgrid

- Calibrated models from rough asset data + utility bills
- Optimized ECM packages
- Not public yet
More Info & Follow-up?

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energy.gov/eere/buildings/building-energy-modeling/
Additional Resources
For More Information

- **NREL/Rocky Mountain Institute**
  - [Building Energy Modeling for Owners and Managers: A guide to Specifying and Securing Services](#)

- **District of Columbia**
  - [Better Buildings Challenge Commitment](#)
  - [Showcase Project: Hotel Monaco DC](#)
  - [Implementation Model: Community Engagement](#)
  - [BuildSmartDC](#)

- **Energy Plus**
  - [Sign up for an account](#)

- **Department of Energy**
  - [Building Energy Modeling](#)
Q & A
Join us for the next Better Buildings Webinar

Registration is now open!

October 6, 3:00 – 4:00 PM ET
Seize the Day – Using Building Milestones as Energy Efficiency Opportunities

Attend this webinar to learn more about transforming building milestones such as purchase, sale, tenant transitions, etc. into energy efficiency opportunities. Presenters from Better Buildings participants University of Virginia, the City of Hillsboro, Oregon, and Arby’s Restaurant Group share their strategies for taking advantage of these milestones to get more from their buildings.

Register [here](#)
Learn more at: [https://www4.eere.energy.gov/alliance/events](https://www4.eere.energy.gov/alliance/events)
Additional Questions? Please Contact Us

betterbuildingswebinars@ee.doe.gov

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