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# APPLICATIONS OF ENERGY MODELS FOR BUILDINGS

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# Modeling Energy Performance

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# APPLICATIONS OF ENERGY MODELS FOR BUILDINGS

Energy performance modeling is a crucial process in building design and operation, aiming to optimize energy efficiency, reduce operational costs, and minimize environmental impacts. It can be approached from multiple perspectives, including whole-building metrics, component metrics, and indoor environmental performance metrics.

# Learning Objectives

- Introduction and Course Outline
- Simulation Comparisons
- **Choose whole-building metrics**
- Evolution of Simulation Techniques
- Baseline Building Models
- Communicate Analysis Results
- Collaborate Within Project Teams
- Applications of Energy Models for Building
- Case Study: Application of BEM
- Summary and Resources
- BEMP Practice Test V.5.1



## INTRODUCTION

- Energy performance modeling optimizes energy efficiency, reduces operational costs, and minimizes environmental impacts.
- Key metrics include cost, site energy consumption, demand, emissions, performance indicators, and component metrics.
- Cost metrics include total energy consumption expenses, while site and source energy consumption quantify energy consumption.
- Demand metrics refer to peak energy usage, and emissions metrics assess environmental impact.
- Performance indicators like Portfolio Manager's Energy Use Intensity and Performance Cost Index provide standardized measures for evaluating energy performance.
- Component metrics examine the efficiency and effectiveness of individual systems and devices.
- Indoor environmental performance metrics focus on the quality of the indoor environment, affecting occupant comfort, health, and productivity.

# UNDERSTANDING ENERGY PERFORMANCE MODELING

Energy performance modeling is crucial for optimizing energy efficiency, reducing operational costs, and minimizing environmental impacts.

## Key metrics include:

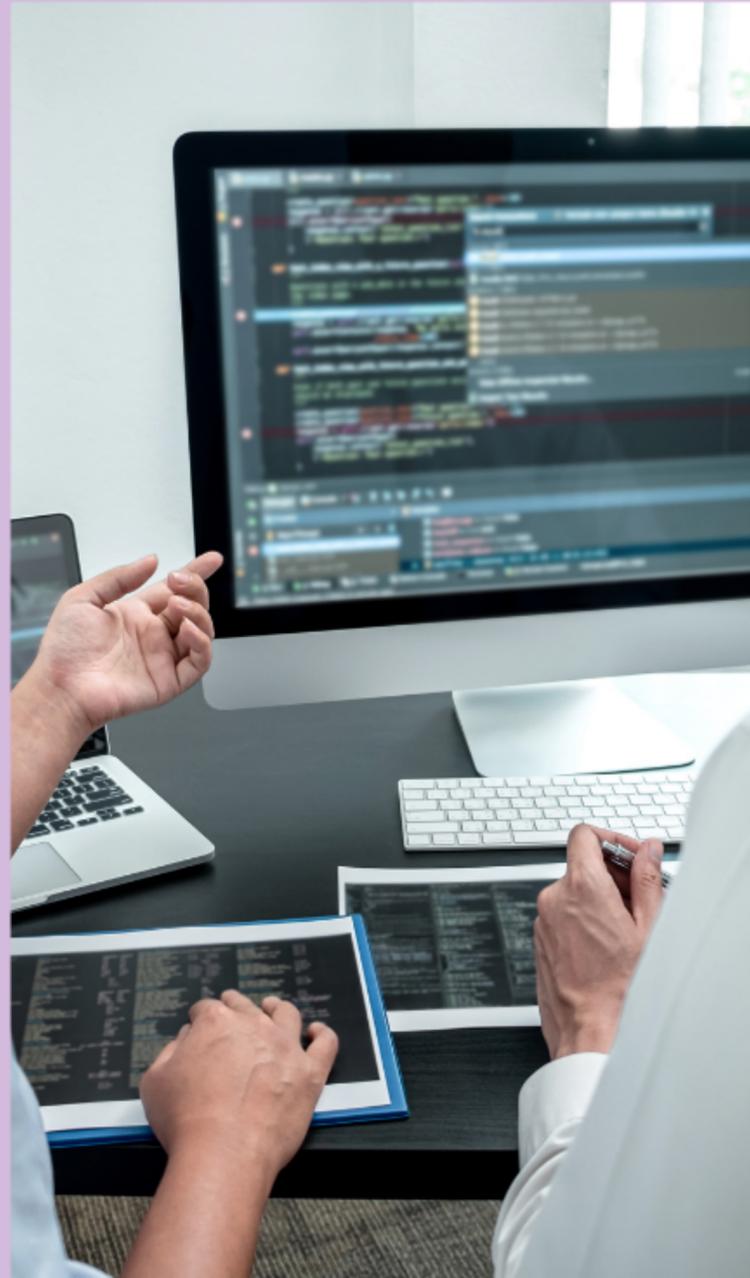
- 1.- Cost: Total expenses associated with energy consumption, including utility bills, maintenance, and operational costs.
- 2.- Site Energy Consumption: Quantifies the amount of energy consumed on-site, indicating how efficiently a building uses the energy it imports from the grid.
- 3.- Source Energy Consumption: Accounts for all the energy required to produce and deliver energy to the building, including transmission losses.
- 4.- Demand: Refers to the peak energy usage of a building, crucial for capacity planning and ensuring energy systems can meet peak loads without overbuilding capacity.
- 5.- Emissions: Assesses the environmental impact of a building's energy use, commonly expressed in carbon dioxide equivalent (CO<sub>2</sub>e).
- 6.- Performance Indicators: Portfolio Manager's Energy Use Intensity (EUI) and Performance Cost Index (PCI) provide standardized measures for evaluating energy performance across buildings.



# COMPONENT METRICS

Equipment Usage: Examines how effectively equipment is utilized within a building, including the operational hours of equipment such as HVAC systems, lighting, and appliances.

- Component Performance: Assesses the efficiency and effectiveness of individual systems and devices.
- Equipment Sizes: Refers to the capacity of mechanical systems, such as air conditioning units and boilers.



# INDOOR ENVIRONMENTAL PERFORMANCE METRICS

Temperature: Measures the thermal comfort within a building, typically maintained between 68°F and 75°F for most spaces.

- Humidity: Assesses moisture levels within indoor environments, typically expressed as a percentage.
- Ventilation Rate: Quantifies the amount of outdoor air supplied to a building, vital for maintaining indoor air quality, reducing pollutants, and enhancing occupant health.
- Daylighting: Assesses the use of natural light within a building, often measured as the daylight factor or illuminance levels.



# WHOLE-BUILDING METRICS



- **Cost:** Includes operational and capital costs associated with energy consumption.
- **Site Energy Consumption:** Measures the total amount of energy consumed at the building site.
- **Source Energy Consumption:** Accounts for the total energy required to operate a building, including energy losses during generation, transmission, and distribution.
- **Demand:** Assesses the maximum power consumption of a building during a specific period.
- **Emissions:** Quantifies the greenhouse gases (GHGs) produced as a result of energy consumption.

# ENERGY PERFORMANCE INDICATORS

- Energy Use Intensity (EUI): Defines the total energy consumed by a building per unit of floor area over a specified time period.
- Primary Energy Intensity (PCI): Expands upon the concept of EUI by incorporating energy losses associated with energy generation and transmission.

## Practical Applications

- Benchmarking: Identifies opportunities for energy savings and improvements.
- Regulatory Compliance: Serves as key metrics for compliance assessments.
- Informed Decision-Making: Uses EUI and PCI data to make informed decisions about investments in energy-efficient technologies, retrofitting existing buildings, or selecting sites for new developments.



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