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FUNDAMENTALS OF URBAN BUILDING ENERGY MODELING

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ONLINE TRAINING BY KRISHNAJI PAWAR

LEED AP(BD+C),GSAS CGP,GCP,ISO 14001

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MODULE 1

Introduction and Course Outline

KRISHNAJI PAWAR - CEO & FOUNDER

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FUNDAMENTALS OF URBAN BUILDING ENERGY MODELING OVERVIEW

Urban building energy modeling is a novel approach for sustainable urban development and energy efficiency. It provides information from building energy analysis, suggesting interventions for effective implementation. Interest in models has led to the development of hybrid models.

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BRIEF ABOUT ME

Krishnaji PAWAR

CEO & FOUNDER



Krishnaji Pawar is founder and CEO of Beyond Smart Cities. Before being named CEO in January 2020, Krishnaji held leadership roles at Beyond Smart Cities in both Sustainability ,Energy & Environmental Consultancy.

Specialized in developing sustainable design strategies for Green Building Certification Systems (LEED, GSAS, etc.), Energy & Water Conservation, Commissioning, Environmental Impact Assessment & Environmental Management Systems.

Currently responsible for 3,787 million square feet Green Building /Energy modeling Consulting since January 2008 in UAE, India and Qatar.

Learning Objectives

- Introduction
- What is urban building energy modeling (UBEM)?
- Why is urban building energy modeling needed?
- What are the available UBEM tools?
- Urban modeling approaches
- How can local weather data be generated and used for UBEM?
- How can results from UBEM be calibrated?
- What are some examples of applications of UBEM?
- Summary and Resources
- UBEM Quiz_Test Your Knowledge!

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INTRODUCTION

- Recently, urban building energy modeling has become an innovative method for identifying, supporting, and improving sustainable urban development and energy efficiency in cities.
- Building energy analysis in urban areas informs urban building energy models and suggests remedies.
- Researchers, urban designers, and regulators are increasingly interested in urban building energy models, leading to the creation of physical and hybrid models.

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INTRODUCTION +

- Complex integrated urban energy planning considers energy flows into, through, and out of cities.
- The building stock contributes significantly to energy use and GHG emissions but also provides remarkable energy efficiency and integrated sustainable energy solutions.
- The need for urban integrated energy planning and the importance of buildings in city energy balancing have led to new city-scale building-oriented studies.
- City-scale energy modeling of buildings helps stakeholders, city planners, and decision-makers understand urban energy systems, create energy plans, propose sustainable initiatives, and develop good policies.
- However, due to buildings' interaction with surrounding buildings and the urban environment, their role in renewable resource envelope solutions, and their dynamic effects on district energy systems, building energy studies have been shifting from individual buildings to cluster and city-level solutions.

URBAN BUILDING ENERGY MODELING





Urban building energy modeling refers to the computational modeling and simulation of the performance of a group of buildings in the urban context, to account for not only the dynamics of individual buildings but more importantly, the inter-building effects and urban microclimate.

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URBAN BUILDING ENERGY MODELING

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- A bottom-up engineering- or physics-based urban building energy model (UBEM) models energy use in a city or district's large structures.
- Analytical tools like UBEMs simulate and depict building energy use and urban energy system behavior.
- The UBEM estimates spatio-temporal patterns of energy flows, both demand and supply, across the metropolis by include energy supply and usage in its definition.
- City planners and policymakers use UBEMs because they can create and study new and current urban regions and systems.



The scope and applicability of UBEMs drive the need and trend for their development to improve city sustainability and energy efficiency.



URBAN BUILDING ENERGY MODELING



- An urban building energy model (UBEM) is a bottom-up engineering-based (or physics-based) model of energy use in large sets of buildings within a specific geographic area, such as an urban district or a whole city.
- An UBEM is an analytical tool that simulates and visualizes patterns of energy use in buildings and gives insight into urban energy system behavior related to buildings.
- Using a broader definition, the UBEM includes not only the use but also the supply of energy and provides an estimation of spatio-temporal patterns of energy flows, both demand and supply, over the whole city.
- In particular, UBEMs can be applied when designing and investigating both new and existing urban areas and systems, which makes them an attractive tool for city planners and policymakers.
- Overall, the extent and applicability of UBEMs motivate the need and the growing trend for the development of such models to aid in improving sustainability and energy efficiency in cities.

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Beyond Smart Cities is the world's 1st Green Technology Marketplace, connecting millions of Sustainability Specialists, Green Building Specialists, Energy Specialists, Commissioning Specialists, Environment Specialists, Health & Safety Specialists, Fire Safety Specialists, Climate Change Specialists & Green Products/Technology Manufacturers with independent talent around the globe.

Our mission is to build and support a global community of experts with the highest professional standards in sustainability, green building, energy, commissioning, environment, health & safety, fire safety, climate change, GHG accounting, carbon auditing, and GHG emissions management.



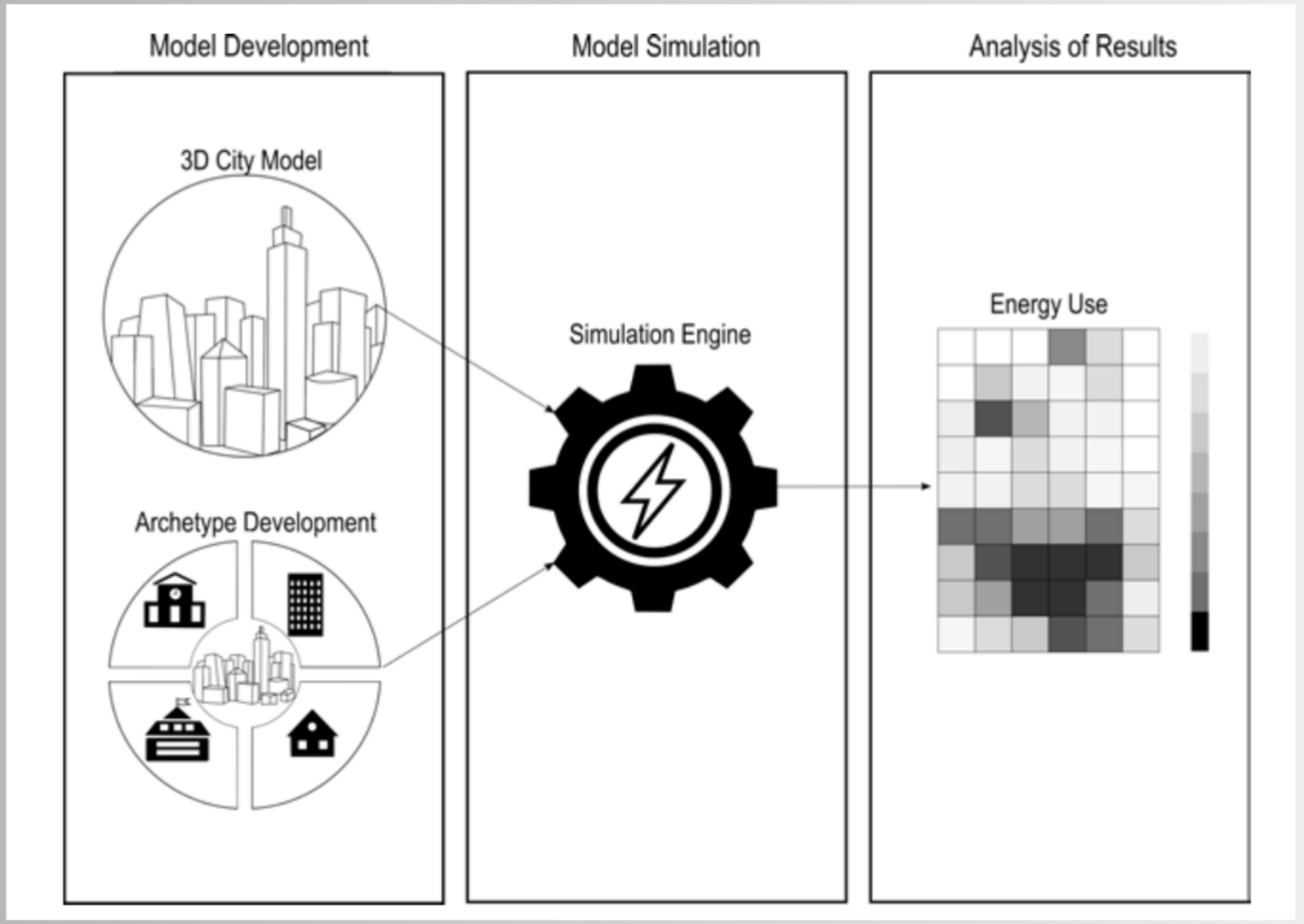
DEFINITION AND PURPOSES OF UBEM



- Due to the preponderance of economic activity and population, cities have the greatest need for energy services (urban energy demand).
- Clarifying the role of cities in global energy systems and their correlation with climate change is of utmost importance.
- Given that urban areas are home to over 50% of the world's population and are projected to account for 75% by 2050, it is imperative that sustainable development traverses urban areas.
- The environment, including energy as a natural resource and quality of life, is negatively impacted by urbanization.

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Overall Urban Building Energy Modeling Workflow





Baseline model : the set of arithmetic factors, equations, or data used to describe the relationship between energy use or demand and other baseline data. A model may also be a simulation process involving a specified simulation engine and set of input data

Boundary conditions :physical conditions (values of physical quantities, conditions of energy interchange, etc.) imposed upon a system at the start or end of a process (temporal boundary conditions) and/or at the boundaries separating the system from its surroundings (local boundary conditions)

Building envelope : (1) outer elements of a building, including walls, windows, doors, roofs, and floors, including those in contact with earth. (2) the exterior plus the semi-exterior portions of a building. For the purposes of determining building envelope requirements, the classifications are defined as follows. Building envelope, exterior: the elements of a building that separate conditioned spaces from the exterior. Building envelope, semi-exterior: the elements of a building that separate conditioned space from unconditioned space or that enclose semiheated spaces through which thermal energy may be transferred to or from the exterior, to or from unconditioned spaces, or to or from conditioned spaces



Urban energy system : a formal system that rep- resents the combined processes of acquiring and using energy to satisfy the energy service demands of a given urban area.

“composition of all components related to the use and provision of energy services associated with a functional urban system, irrespective where the associated energy use and conversion are located in space “

Urban building energy modeling : UBEM involves developing energy models of buildings using their geometric and non-geometric features and simulating them in a simulation engine, just like BEM.

The modeling process is more complicated and fraught with uncertainty.

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