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Seminar 55 – Urban-Scale Energy Modeling, Part 4

Urban-scale Building Energy Modeling: Why Working at Scale Matters

Learning Objectives

1. Awareness of the relationship between microclimate and building energy use
2. Optimization by climate zone for energy efficiency of neighborhood building morphology.
3. Provide an overview of UBEM techniques and data sources.
4. **Describe how UBEM can be used to make well-informed utility planning decisions.**
5. **Recognize significance of analytical problems that can be addressed at urban scale that cannot be well addressed at the individual building level.**
6. Recognize key structural and operating requirements for an urban-scale energy modeling platform.
7. Explain how urban scale models can be created
8. Understand usefulness of building energy benchmark data in an urban context

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- NYC Mayors Office of Resilience and Sustainability
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  - Ellen Ryan
- Dr. Ursula Eicker, HFT Stuttgart

Outline/Agenda

- Goals
- Current and On-going Work
- Examples of Where/How Urban-scale Building Energy Modeling Makes a Difference

Goals

Of the Work

- To provide decision-making tools for city sustainability planners globally
  - City Mayors globally are becoming active in climate change programming and many other urban environmental considerations

Of this Presentation

- To consider applications that can be achieved with urban-scale energy modeling tools

Current Work

CUNY researchers with EU team led by HFT Stuttgart

- Develop integrations in/to **cityGML** format to encourage standardization of data structures
- Develop and promote applications in NYC working with municipality and with the local utilities

Align with others doing similar work

- Boston
- SF Bay area
- Chicago

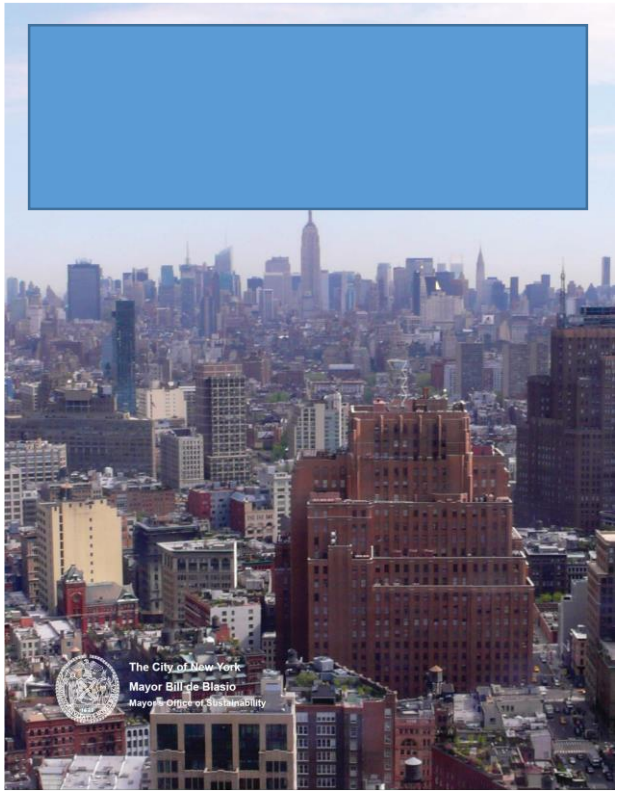
Current Work: Modeling Work Flow

- Building stock characterization – “archetypes”
- Modeling of archetypes, including calibration
- Building data from data sets or geographical sources
- Characterization of buildings in defined locale to archetypes
- Mapping of energy use
- Simulations of technology (and/or behavior) changes

Decision-Making & Actions

- Municipalities leading the way in energy and carbon policies

- Urban Sustainability Plans
  - Plans set municipal targets
  - What kinds of actions must be taken at the building level to meet these targets?
  - Can actions at aggregated and/or community scales accelerate progress?
  - Combine multiple criteria



Cross-disciplinary Bridge

- Urban Planners and Building/Energy Engineers don’t communicate
  - Goals established without a detailed understanding of how to achieve them
  - Actions taken without full analysis of impacts

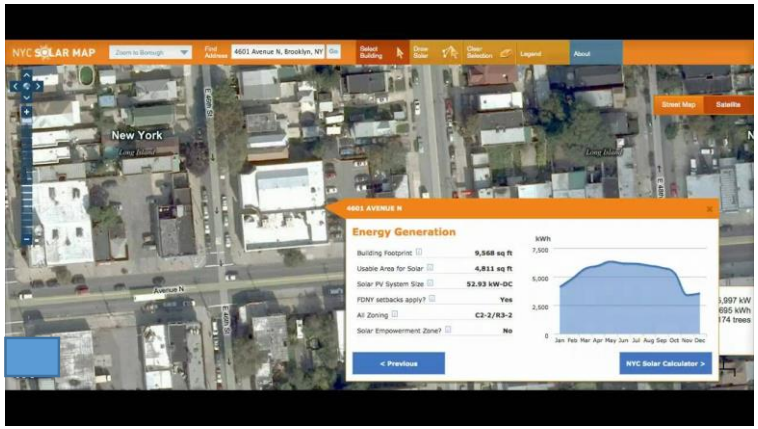
- Mapping visualization provides a bridge
  - Integrate engineering tools to a scale that planners can use effectively
  - Provide analytic capabilities to explore scenarios

Decisions that require multi-building coordination

- Zoning
  - How new constructions will affect existing communities
  - Ralph Knowles “Solar Access Design” and “Solar Envelope”
- Technologies with multiple building interactions –
  - cogeneration, district heating/ cooling
  - utility load management
- Multi-criteria integrations
  - Micro-climates, urban heat islands
  - Air quality
  - Resilience – storm vulnerabilities
  - Social and economic indicators

Example: Solar Provisioning

What does a city need to do to reach fully renewable energy?



- Solar Mapping and Solar Potential Studies
  - Rooftop mapping – area calculations
  - Next level of detail – available roof, shading
- Solar Fraction
  - Integrates electricity reduction programming with production
- Remaining balance is what city/utility needs to provision from external sources

Example: Exterior Insulation

- How to identify and count appropriate locations
  - Street façades constrained by aesthetics
- Use algorithmic mapping functions to identify non-street facades
  - Rear and side walls, courtyard walls
  - Aggregate calculations
  - LOD required?

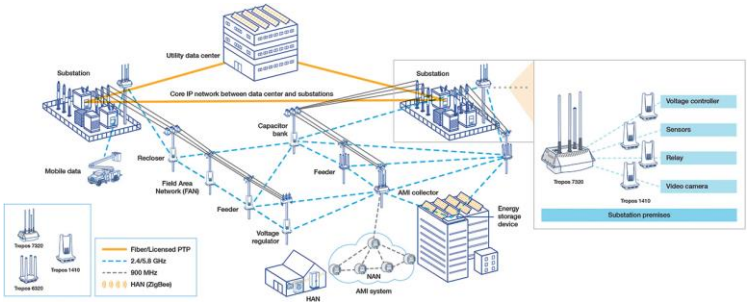
- Support program roll-out on a systematic basis

Building Clusters

- Mapping enables aggregations at selected scales
- Define localities
  - Communities - “Community Energy” concepts
  - Utility distribution networks
  - Water sources – for water-source heat pumps
- Explore technology impacts

Example: Load Management

- NYC Municipal Buildings and local utility load management
- Aggregate muni buildings by utility distribution networks
  - Assess near-term impact potentials (DSM)
  - Assess longer term technology impacts
- Develop collaborative policies



Multi-criteria Applications

- Resilience priority zones
  - Urban Heat Islands as antecedent
- Neighborhood Air Quality
  - Pinpoint sources
  - CFD analysis - What do local air flows look like under varying conditions? What thermal and/or public health impacts?

Conclusions

- There are distinct sets of problems that can be addressed
- Standardized approaches and tools would help share solutions between cities

QUESTIONS?

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