

2016 Annual Conference

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Seminar 56 - Data Sources toward Urban-Scale Energy Modeling, Part 2

Techniques for Rapid Generation and Visualization of Urban-Scale Energy Models

St. Louis, Missouri

Learning Objectives

1. Identify what building information is needed to create energy models that provide useful results at an urban scale
2. Understand whether and how urban scale energy modeling can augment building-level audits, meter data analysis, and benchmarking
3. Understand how geographic information and simplified building energy model be integrated for urban scale building energy modeling, and how urban context would affect aggregated energy consumption
4. Explain the relationship between microclimate and building energy use.

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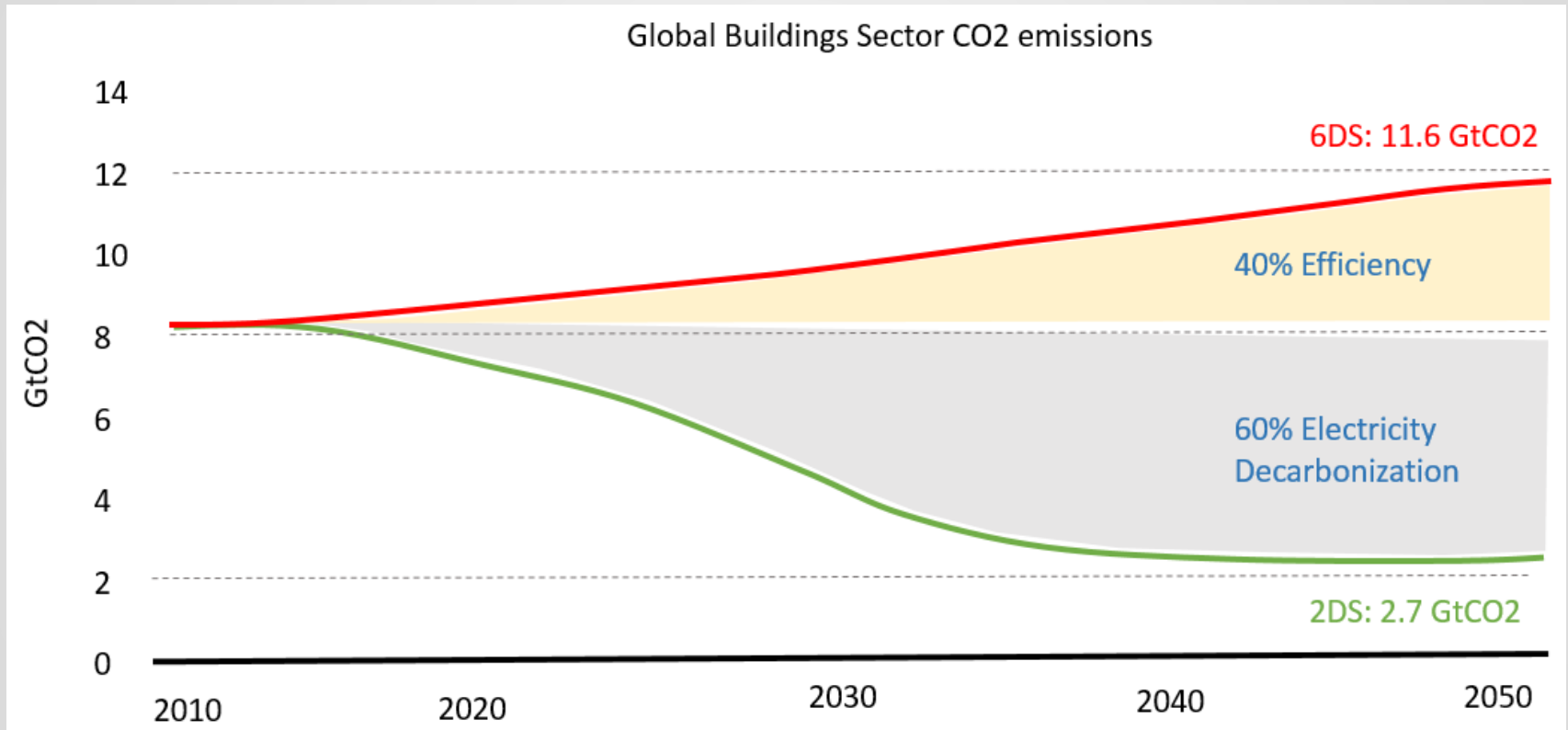
Acknowledgments

- Moiz Kapadia - RetroEta
- Emma Stewart - Autodesk
- Mathews Mathai - Autodesk
- Insight360 team
 - Krishnan Gowri
 - Ian Molloy
 - Barry Tsai

Outline/Agenda

- Who is the target consumer?
- Maturity of existing energy information technology
- The role of geospatial inputs/results, and current examples of geo-referenced energy interfaces
- Example projects using automated geometry and energy model creation and visualization

Climate Stabilization Depends on Progress in Buildings



**“Without data
you’re just another person
with an opinion”**

-- W. E. Deming



Energy Information is a Barrier to Progress

5 B

ft² of US space is Benchmarked

311 B

87 B ft² US Commercial
224 B ft² Residential

98%

of building stock
lacks information
(95% of commercial?)



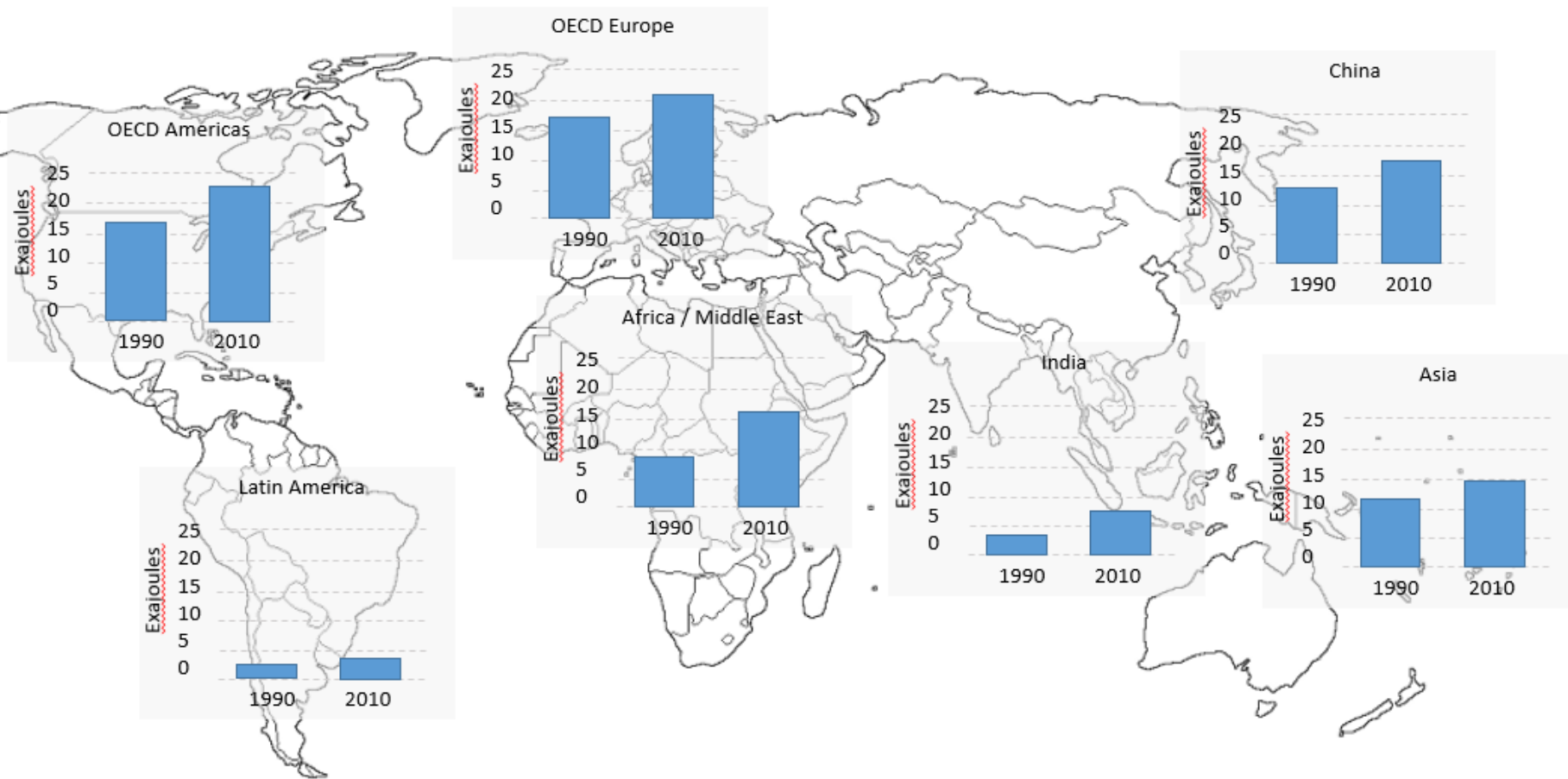
Manual Auditing and Benchmarking is Time-Consuming

How long to audit all US commercial buildings?

23 yrs

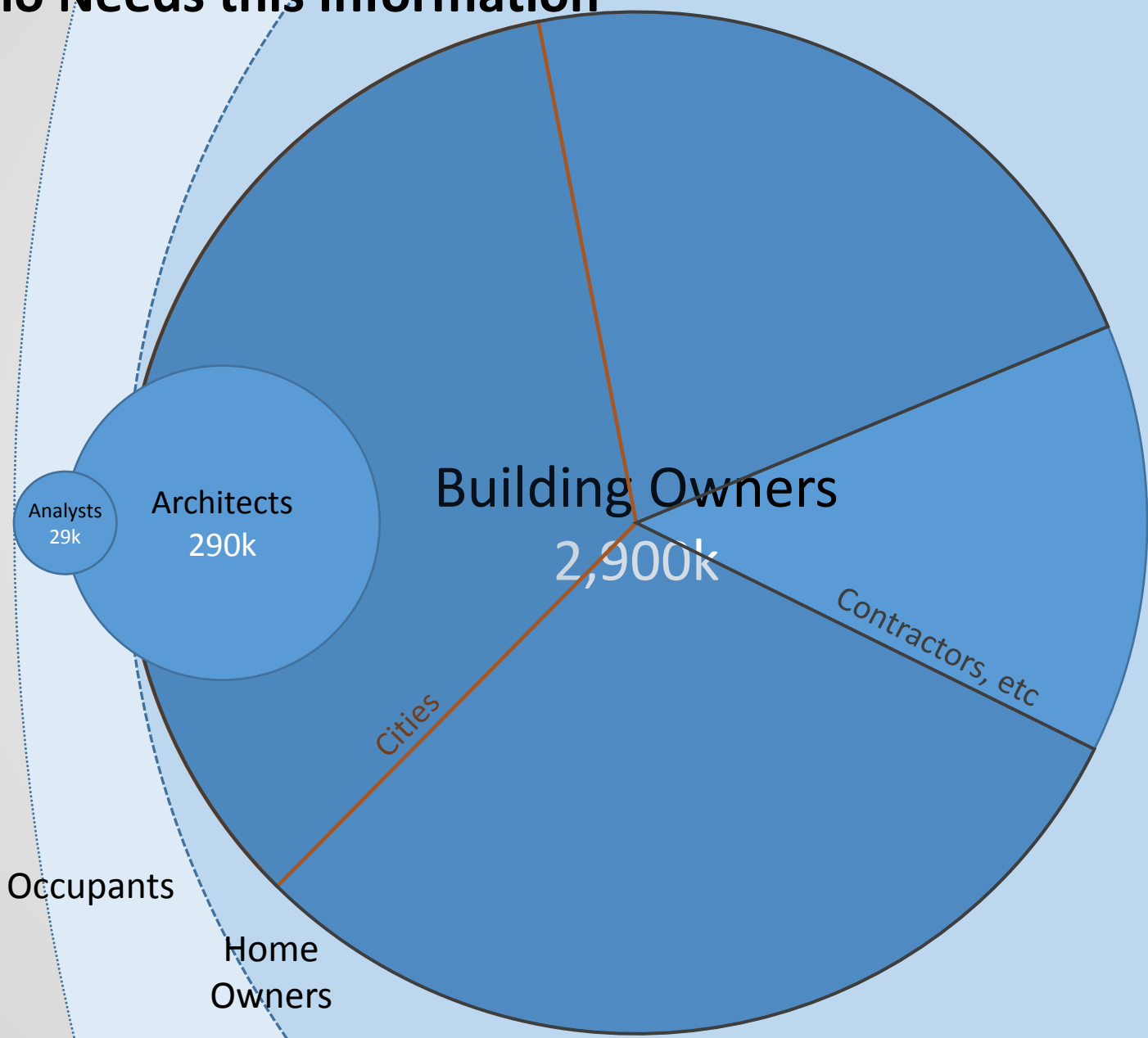
Time it would take 1,000 full-time auditors working full time to conduct 1 day audits on entire US commercial building stock of 5.6 M buildings – Adapted from ICF International reference, 2010

Urbanization is an opportunity





Who Needs this Information



Solving User's Problems Using Massive Energy Modeling

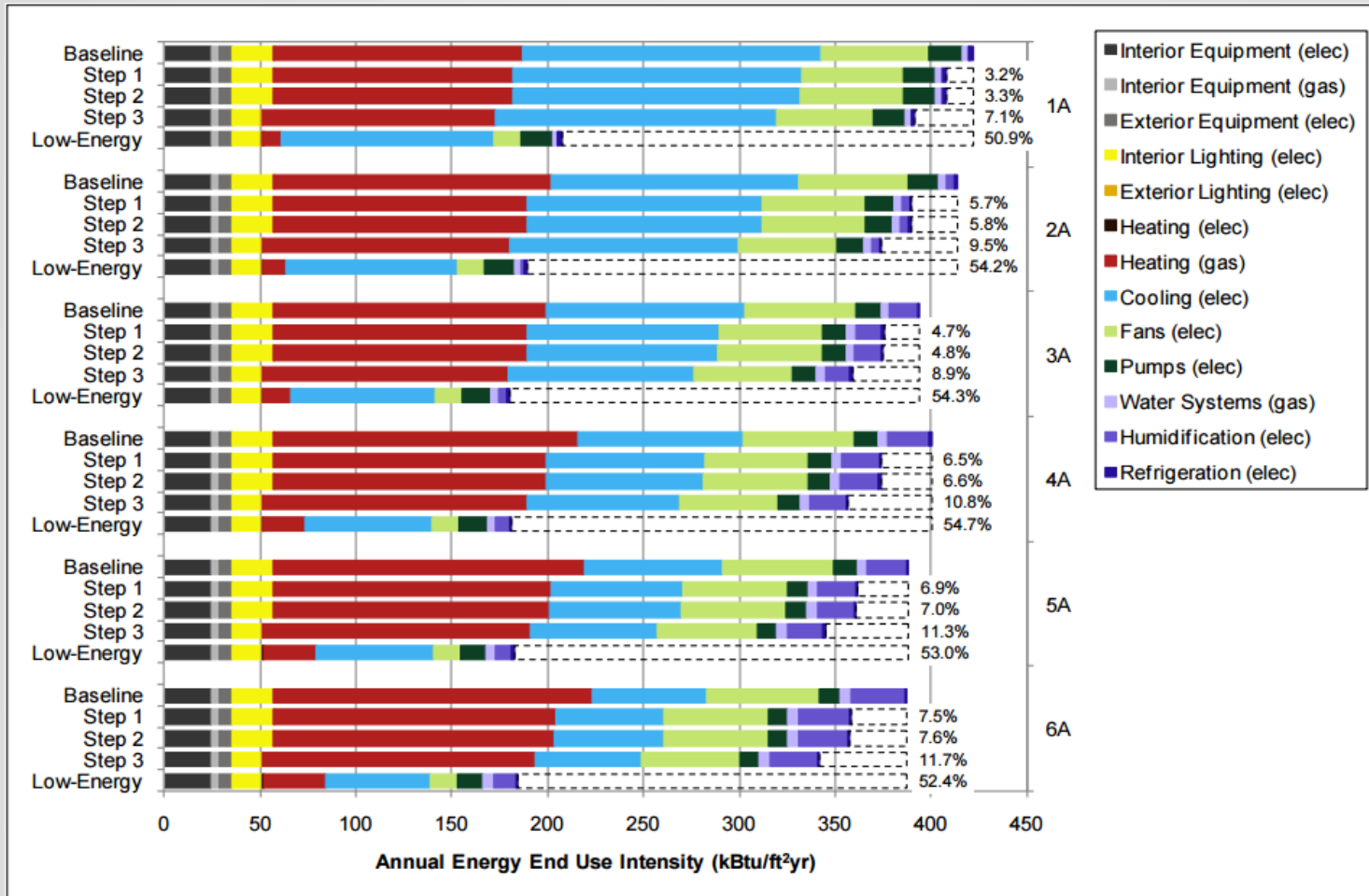
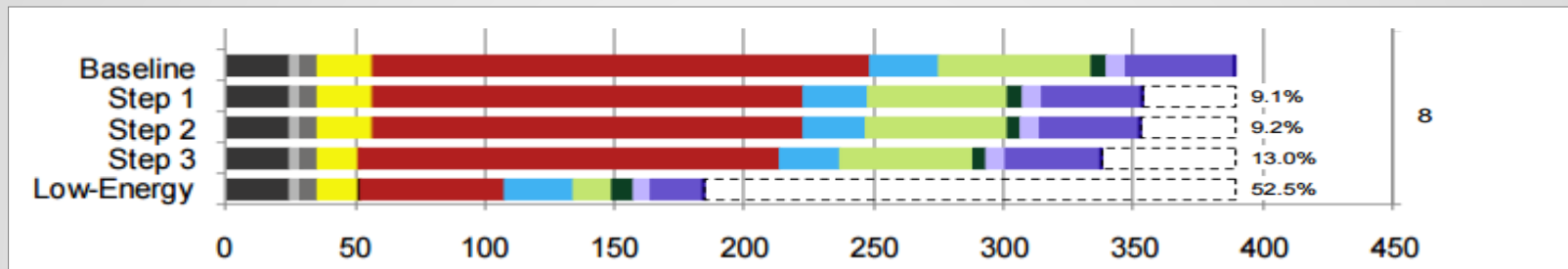


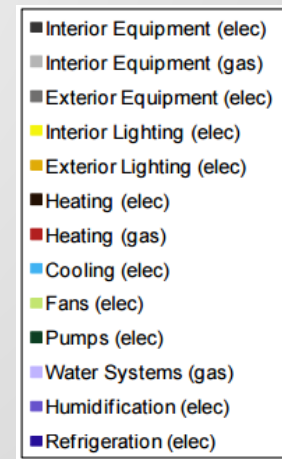
Figure 5-2 Bundle analysis results for humid climate zones
(Credit: Eric Bonnema/NREL)

Solving User's Problems Using Massive Energy Modeling

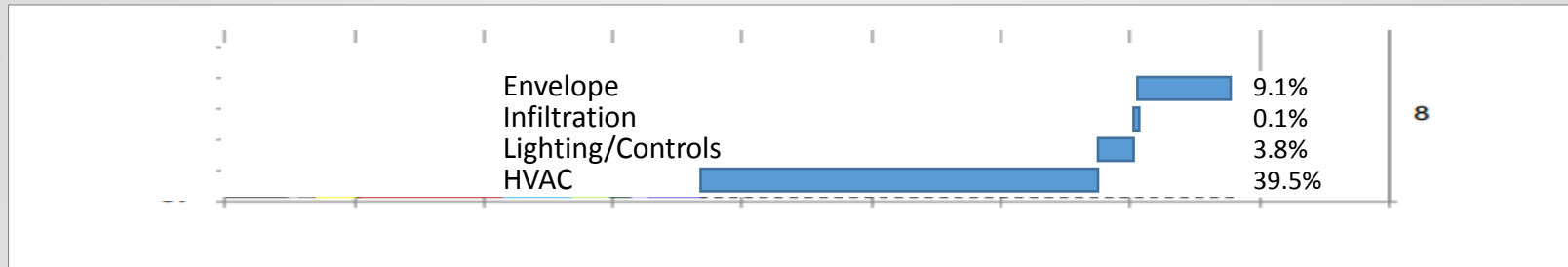


AEDG – Advanced Energy DesignGuide
 Large Hospital 50% Energy Savings:
 Technical Support Document

1. Apply envelope efficiency measures, which included adding overhangs to the south windows and upgrading the building materials in accordance with Section 3.2.
2. Reduce infiltration in the exterior zones from 0.3 ACH to 0.25 ACH, representing a tighter envelope construction (see Section 3.3).
3. Reduce interior and exterior LPDs and add daylighting controls and occupancy sensors to applicable zones (see Section 3.6).
4. Change HVAC system type from CAV AHUs to a DOAS/WLHP system (see Section 3.7).

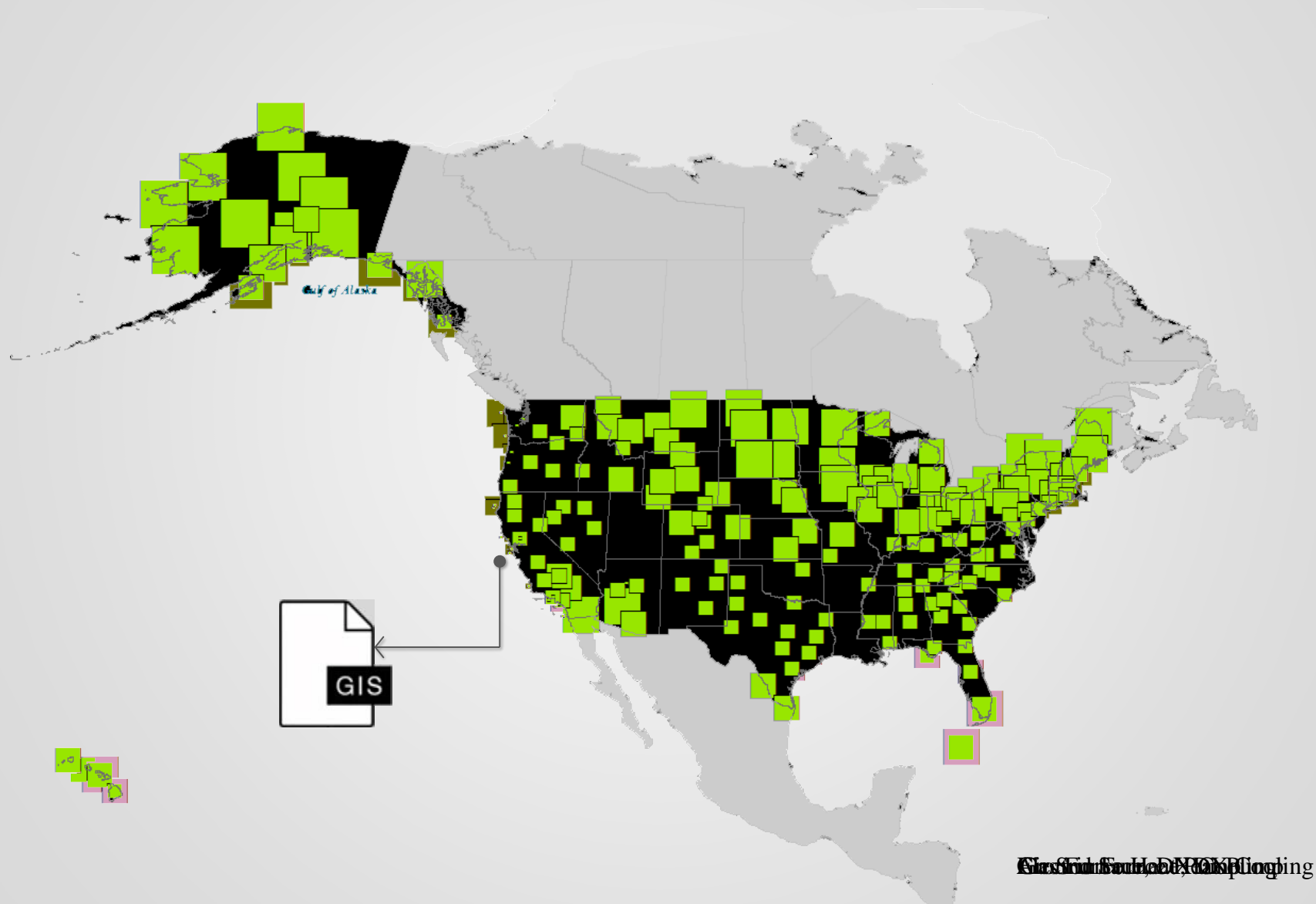


Solving User's Problems Using Massive Energy Modeling

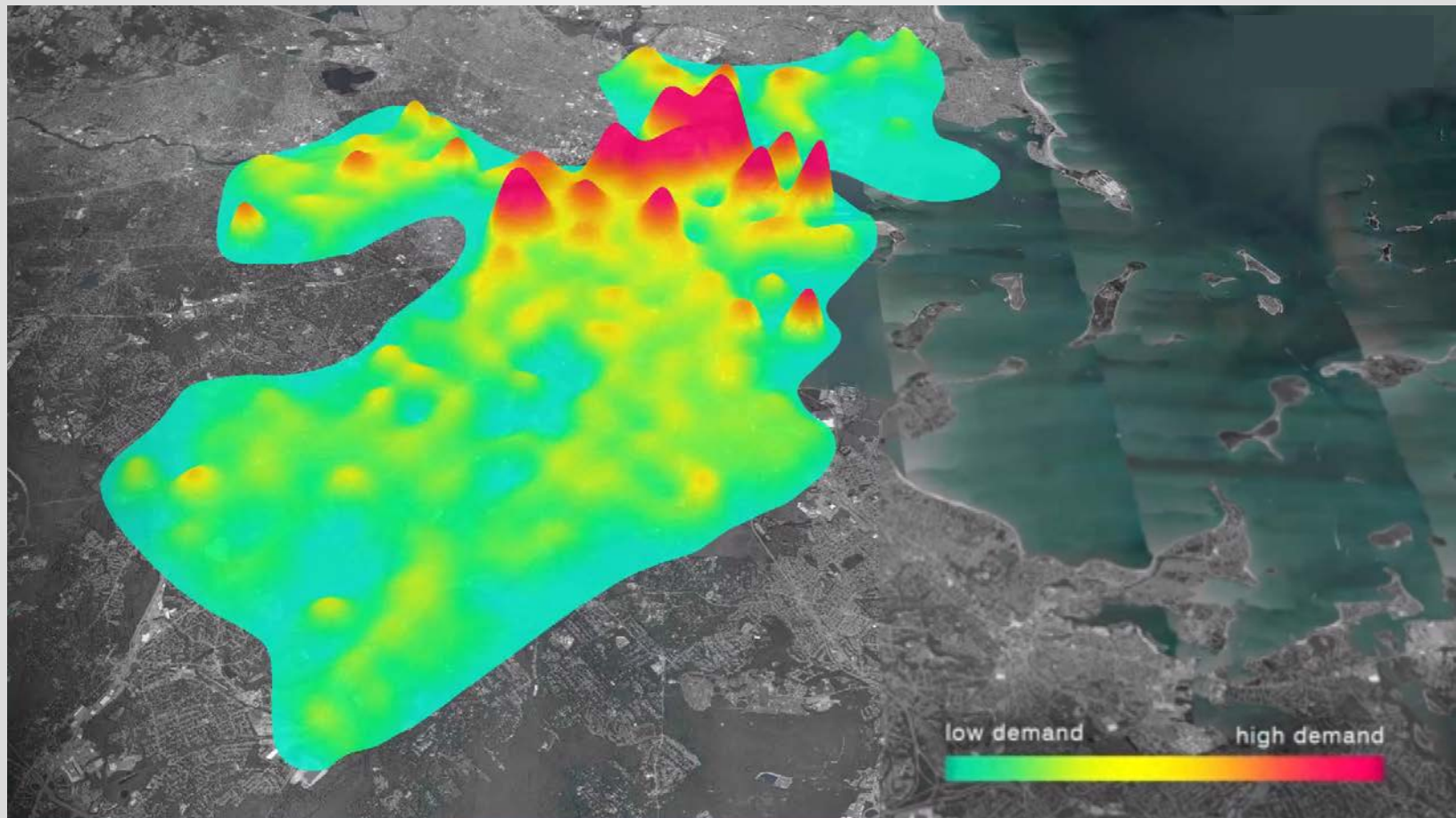


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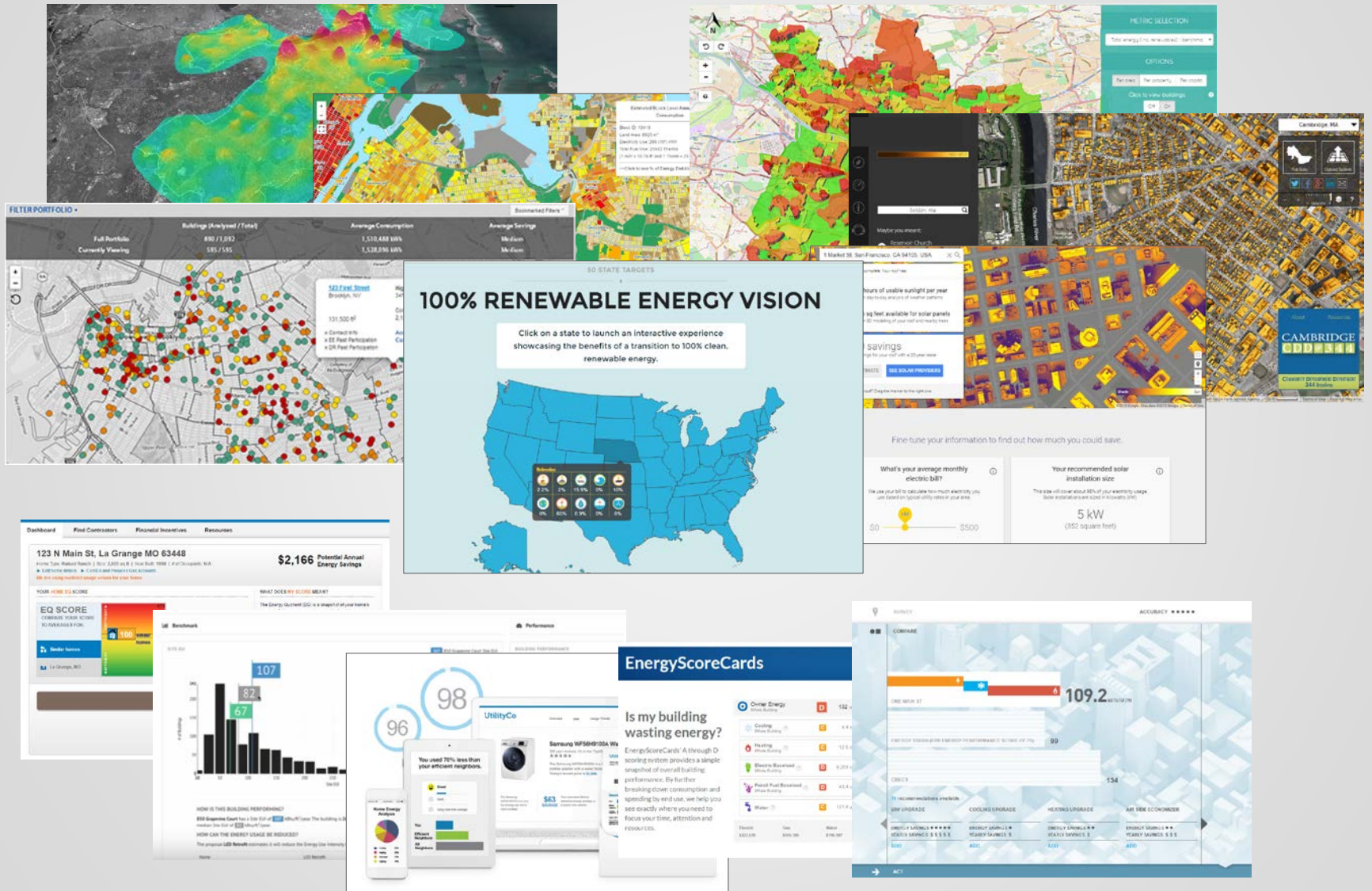
Problem Solving Using Geo-Referenced Energy Models



Problem Solving Using Geo-Referenced Energy Models



Delivering Results of Geo-Referenced Energy Models



Delivering Results of Geo-Referenced Energy Models

The screenshot displays a web application interface for energy modeling results. The main content area features a 3D city model background with a central energy performance metric of **61.6** kBTU/SF/YR. Above this, a bar chart shows three values: -4.3, -5.6, and -37.7. Below the main metric, an ENERGY STAR® (EPA ENERGY PERFORMANCE SCORE OF 75) score of **99** is displayed. To the right, a CBEC\$ score of **134** is shown. A section titled "2 selected / 9 recommendations remain" lists four upgrade options:

VAV UPGRADE	COOLING UPGRADE	HEATING UPGRADE	AIR SIDE ECONOMIZER
ENERGY SAVINGS ●●●●● YEARLY SAVINGS \$ \$ \$ \$ \$	ENERGY SAVINGS ● YEARLY SAVINGS \$	ENERGY SAVINGS ●●● YEARLY SAVINGS \$	ENERGY SAVINGS ●●● YEARLY SAVINGS \$ \$ \$
REMOVE	REMOVE	ADD	ADD

At the bottom, an "ACT" button is visible. The interface also includes a navigation menu with "Login", "Register", "About", "Methodology", "Get Started", and "Contact". A "SURVEY" tab is active, and an "ACCURACY" indicator shows five dots, with the first four filled. The background features a 3D city model and a map of Cambridge, MA.

Delivering Results of Geo-Referenced Energy Models

COMPARE ACCURACY ●●●●●

ACT

VAV UPGRADE COOLING UPGRADE

ENERGY SAVINGS ●●●●● YEARLY SAVINGS \$ \$ \$ \$ \$

ENERGY SAVINGS ● YEARLY SAVINGS \$

Your savings

Energy Savings **43.6% ↓ 47.6** kBtu/SF/YR

Cost Savings **\$239,000** /Year

You qualify for the:

Large Commercial Retrofit Program

In partnership with [redacted], we are excited to offer a program to sell energy efficiency as a service to large commercial and industrial projects. In this program, Transcend will directly fund energy efficiency measures, and directly pay the utilities on behalf of the building. The building owner will pay Transcend on a monthly basis what the utility bills would have been had the energy efficiency measures not been installed for a set period of time - typically 10 years. After this period ends, the building owner resumes paying the utilities directly, reaping the savings from the improved energy efficiency of the building. The services charge is an auditable operating expense to tenants and does not impact the underlying financing (e.g. mortgage) for a building. Projects must be readily aggregated to at least 200,000 square feet.

I'm interested in:

- Energy Auditing
- Financial Incentives
- Financing Options

[Request Info](#) [Explore more options](#)

Would you like to have a conversation?

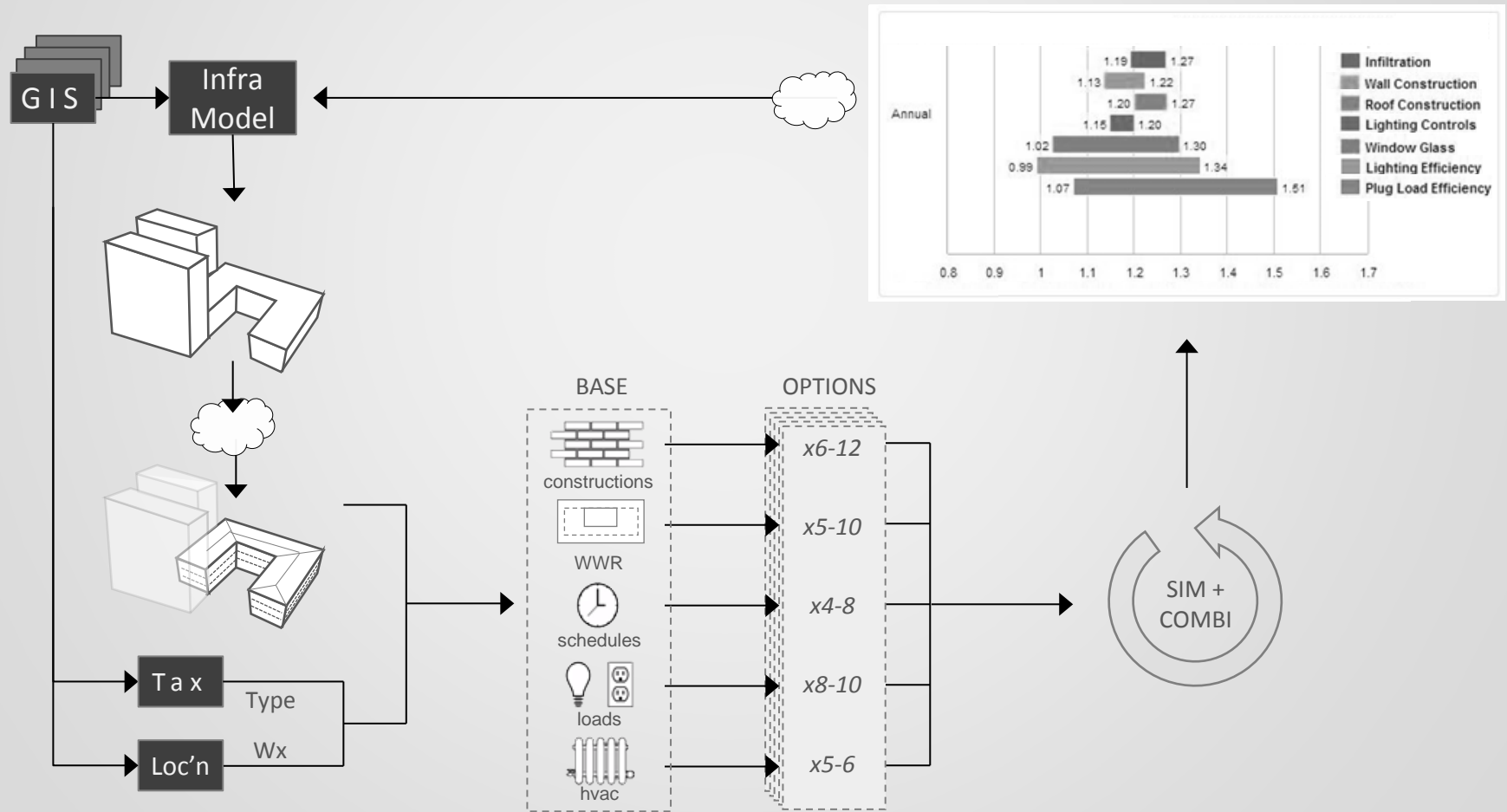
Automated Urban-Scale Energy Simulation & Results

- Built-in worldwide building (& context) AOI geometry generator
- Automated pseudo-full factorial range simulation
- ECM/retrofit characterization & visualization
- Aggregation & custom analytics

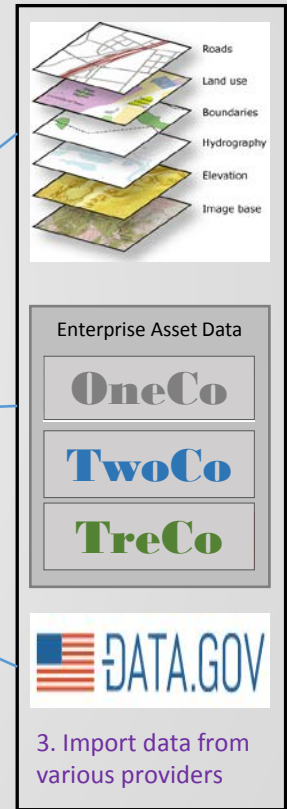
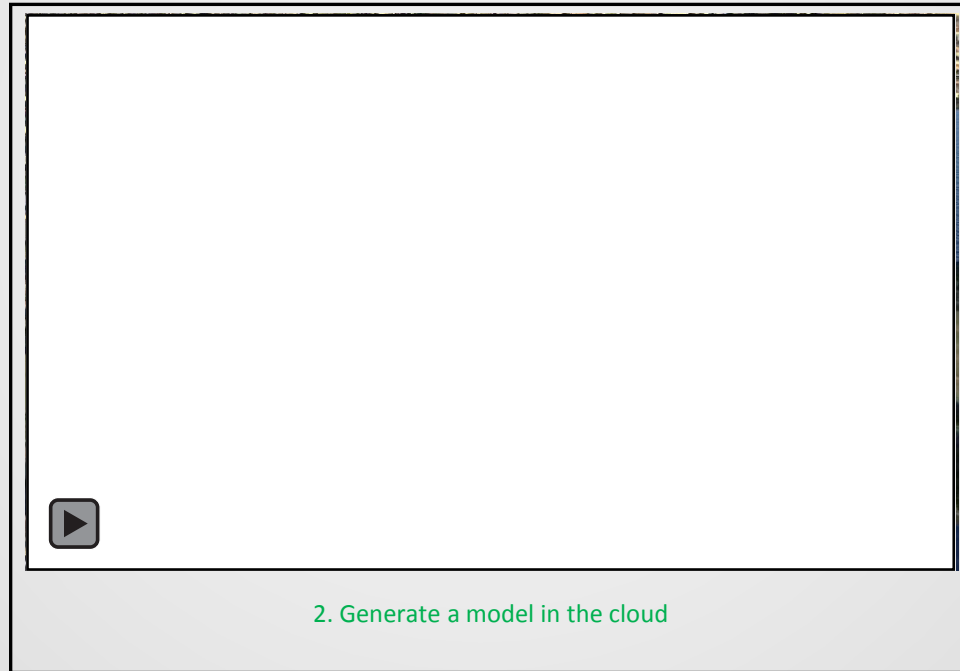
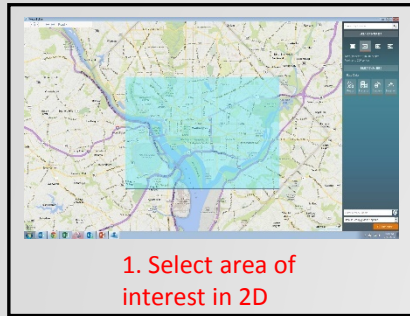


Automated Urban-Scale Energy Simulation & Results

- Built-in worldwide building (& context) AOI geometry generator
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Automated AOI Building & Context Geometry



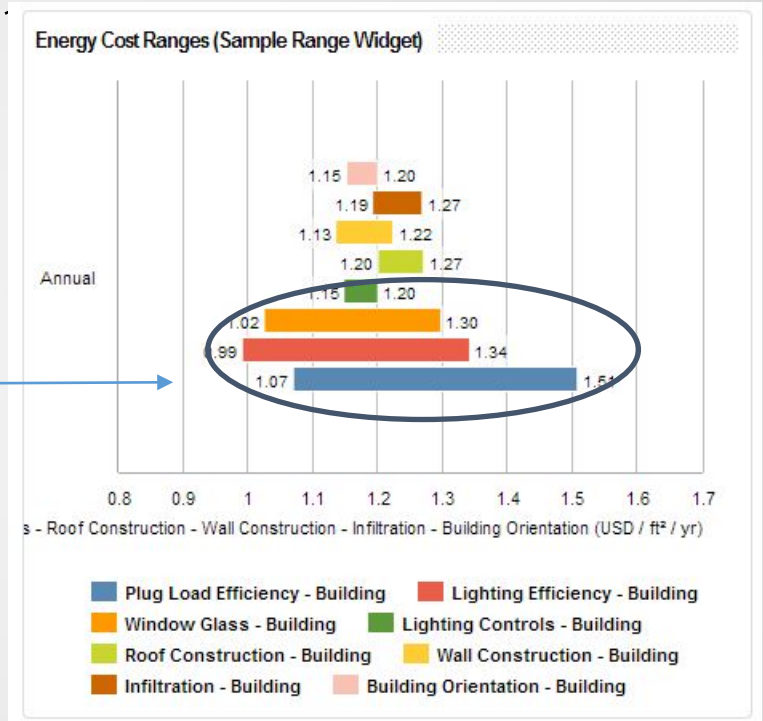
Automated Pseudo-Full Factorial Simulations for Sensitivity



XXXX Pennsylvania Ave

Target Windows, Lighting, and Plug Loads systems for review

Wider bar, = greater impact of a change or retrofit



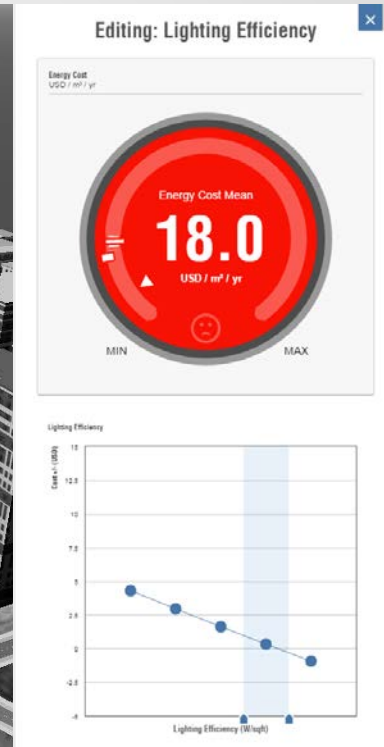
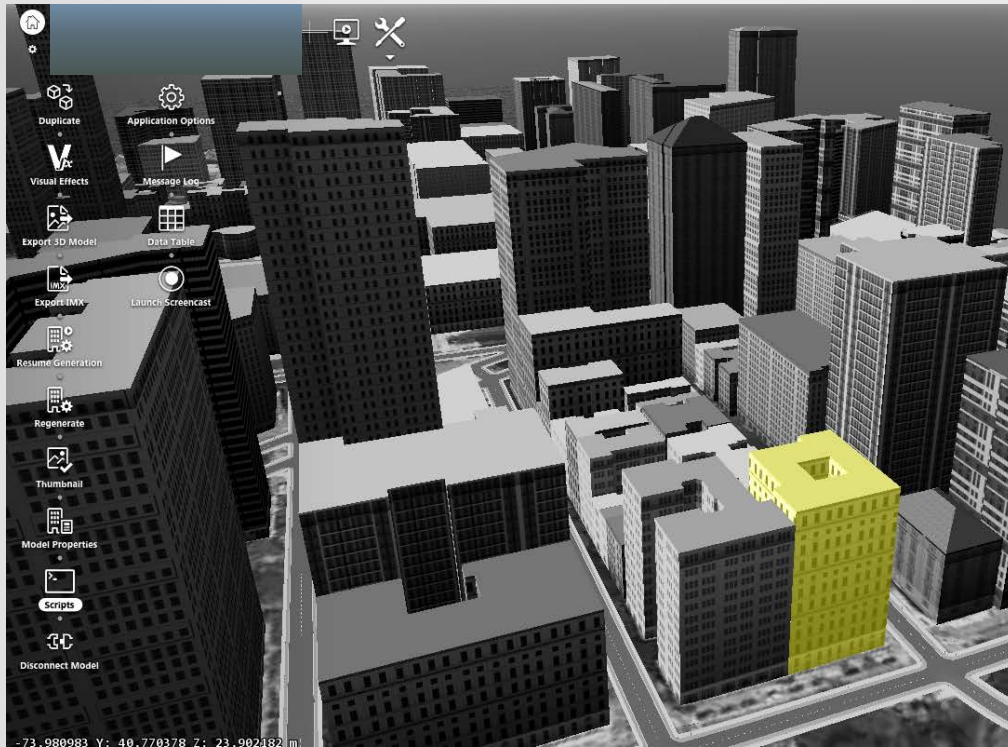
Model-Supported Platform Allows Building- or Portfolio-Level Iteration, Calibration and Project Management



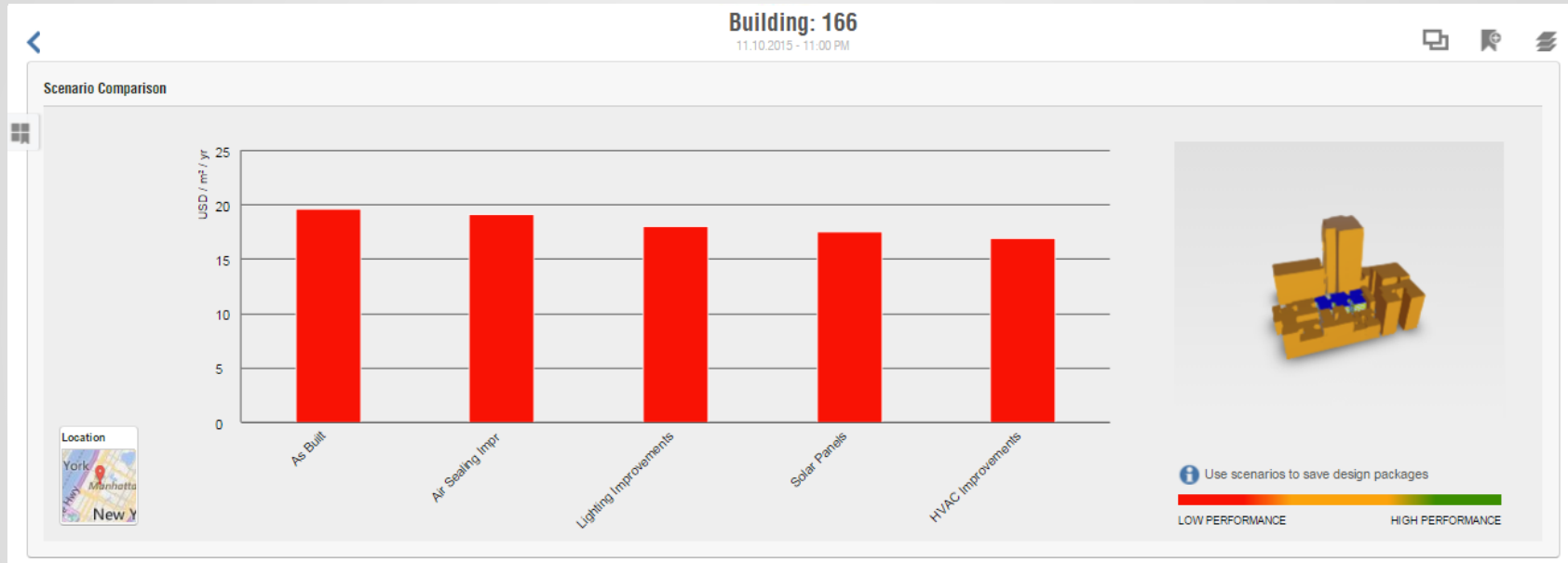
Iteration, Calibration and Project Management in the Design Environment



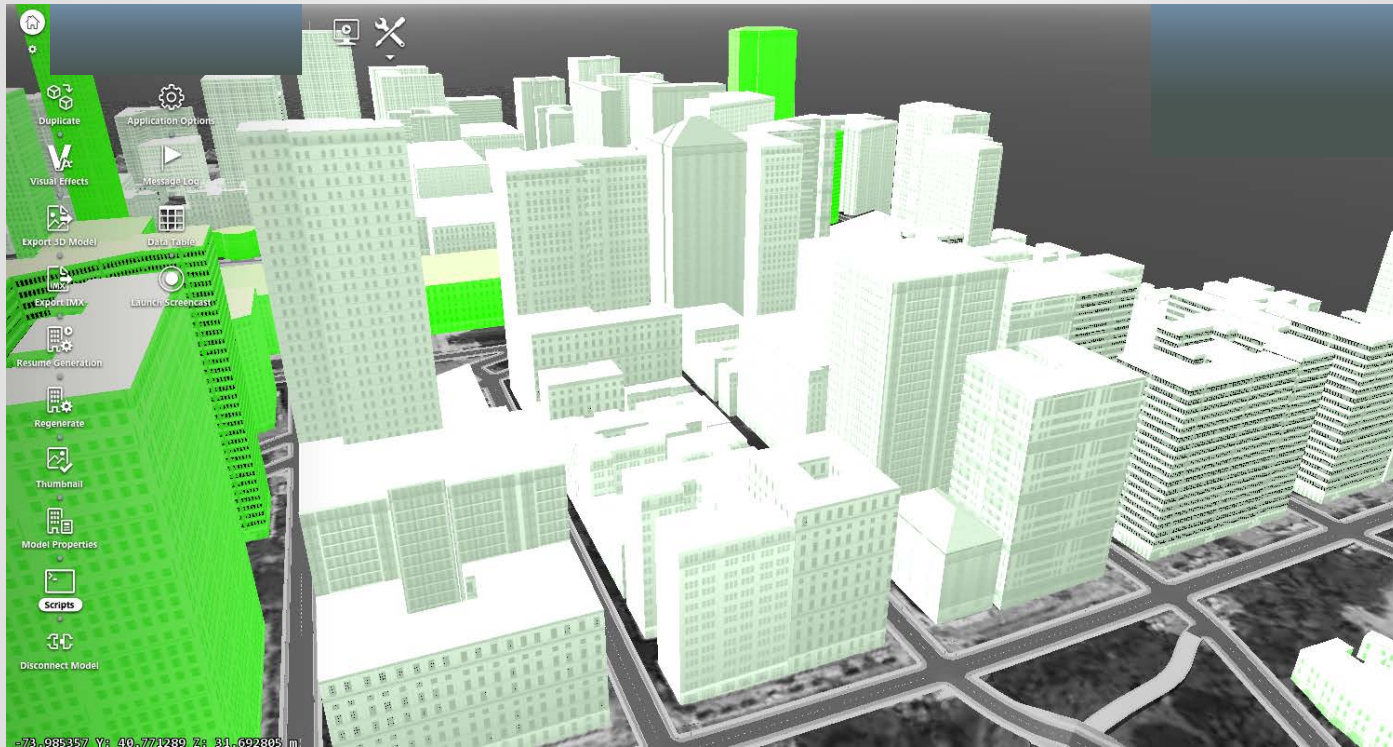
Iteration, Calibration and Project Management in the Design Environment



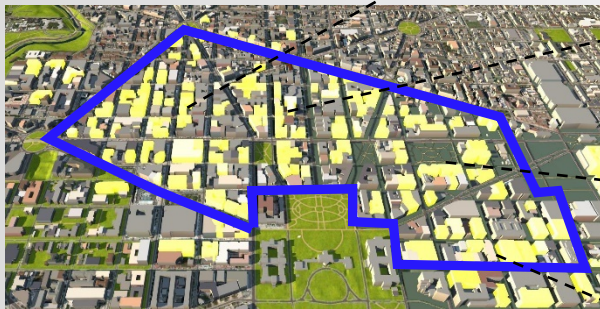
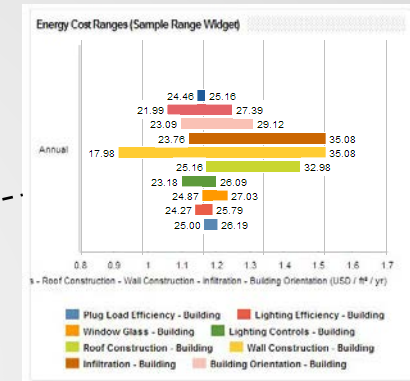
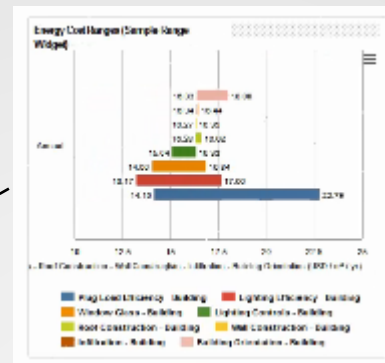
Building Level ECM Comparison and Iteration



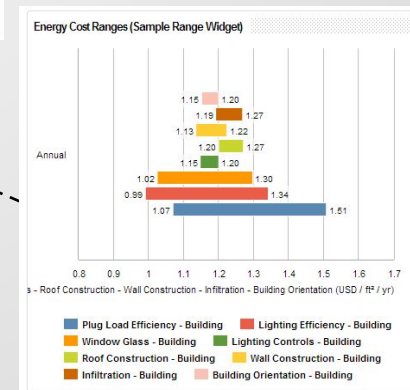
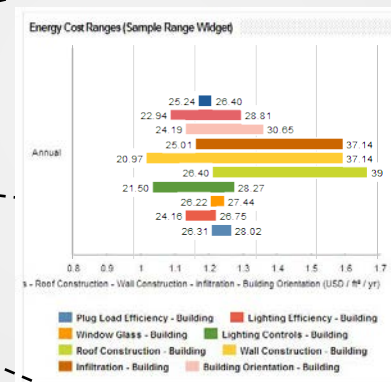
District Level Policy or Incentive Comparison and Iteration



District Level Aggregation for Policy-Type Decision Making



Offices in DowntownDC ecoDistrict

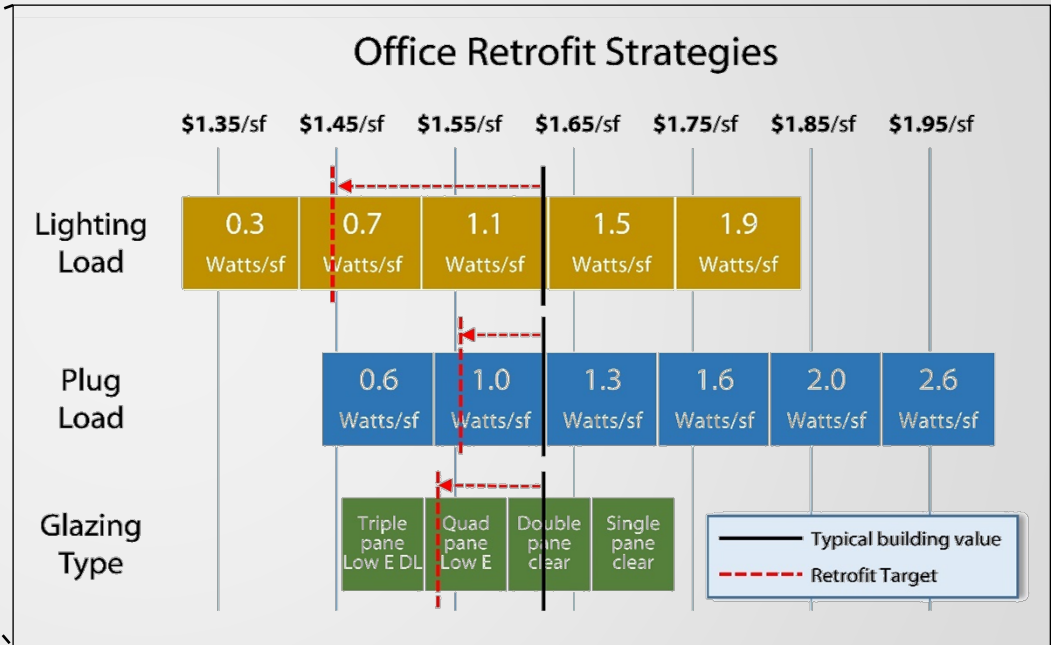


District-Level Aggregation for Policy-Type Decision Making

(Law of large numbers)



Offices in DowntownDC ecoDistrict





GOVERNMENT OF THE DISTRICT OF COLUMBIA
District Department of the Environment



Smart Buildings Plan Project

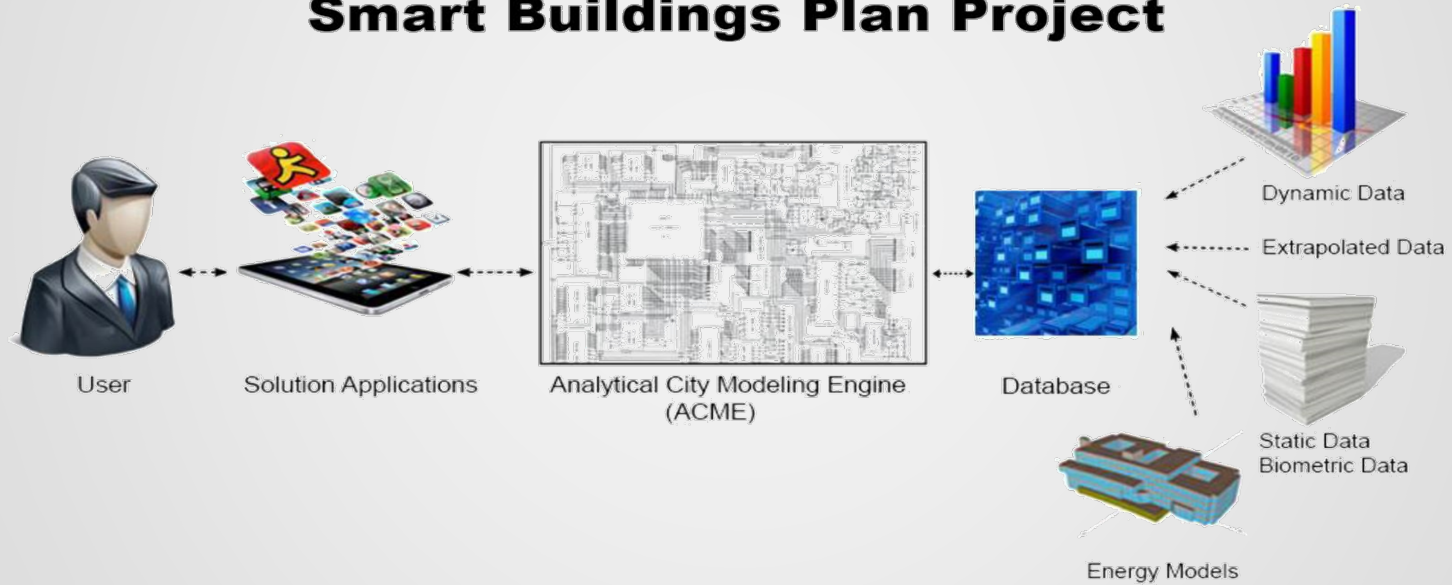


Figure 1 the District City Model

Image Source: Smart Buildings Plan Project, Technical Report FY 2014

Conclusions?

- What is the most impactful target audience for energy analysis results?
- What can stakeholders do if they don't have meter data or individual building details?
- Is archetype-based pre-simulation useful for decision-making at the urban/district or building scale?
- How 'good' does a model need to be to provide actionable retrofit information at each scale?
- What kind of trouble do we stir up by publishing building-level results? District-level results?

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Questions?

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