Potential Demand Reduction from Buildings in a Simulated Utility

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Motivation: BEM for every U.S. Building by 12/31/2020

Methodology: Scalable compute, data, simulation, and empirical validation

1. Quantitatively rank most important building inputs

Sensitivity Analysis

3. Identify and compare data sources for important inputs

Comparison Matrix

Goal: Stimulate private sector activity and academic research for a sustainable built environment

2. Time on world's #1 fastest high-performance machines

Supercomputers

4. Establish partnerships and APIs for scalable data retrieval

Satellite/Aerial Imagery

StreetView

LIDAR

Databases

5. Algorithms to extract building properties

Window-to-wall ratio

Computer Vision

6. Create OpenStudio and EnergyPlus models

DOE Prototype Buildings

7. Make models freely available online

Download BEM via street address

IGA:
- Walkthrough Audit
- Calibration to measured data
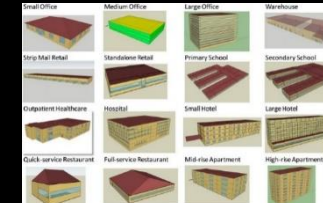
Use cases:
- Simulation-informed analysis
- Sales/market leads
- Utility program formulation
- Automated financing

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Urban building energy sensing, controls, big data analysis, and visualization Workshop '19 | New York, NY | Nov 10, 2019
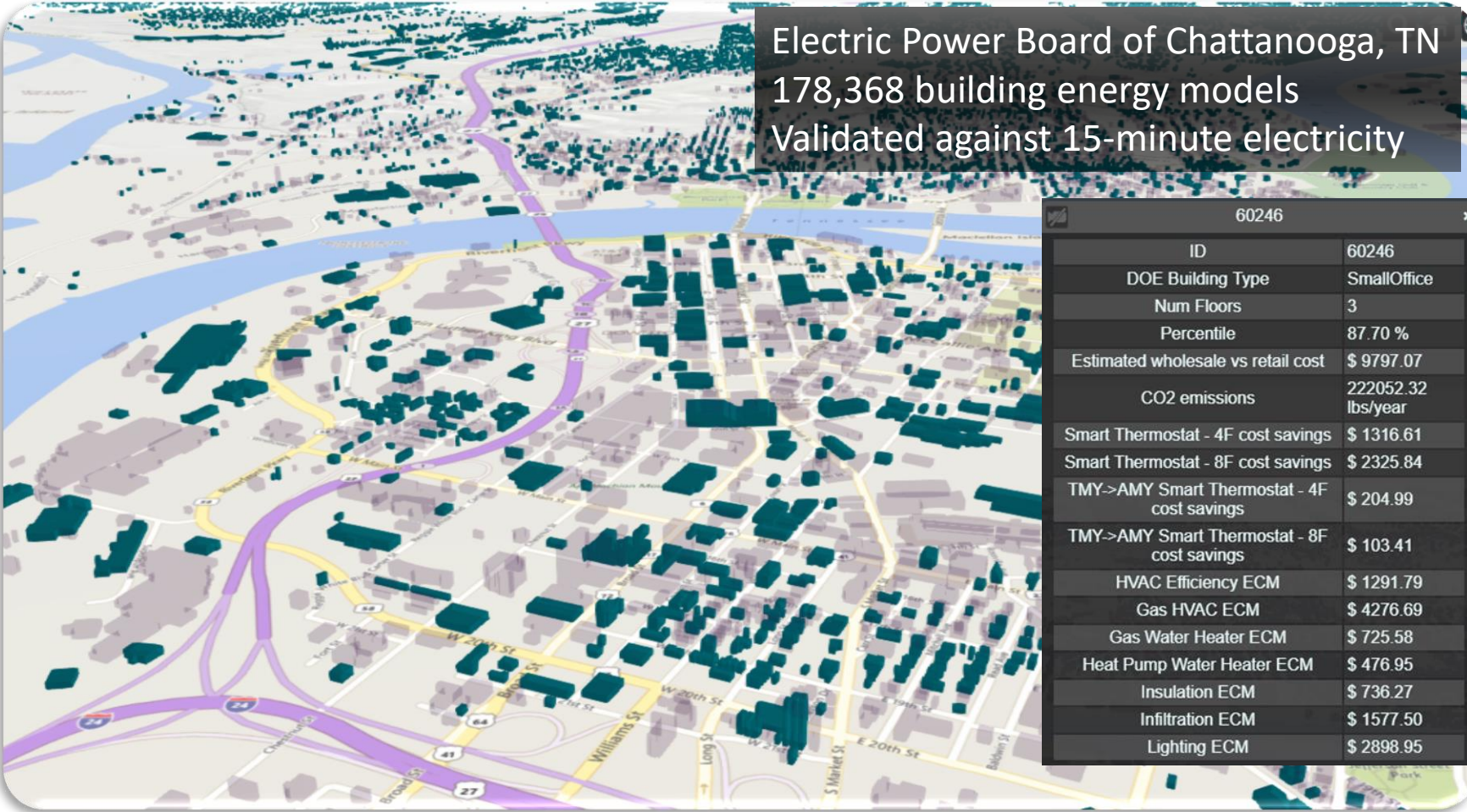
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Results: Digital Twin of Campuses and Virtual Utility

Electric Power Board of Chattanooga, TN
178,368 building energy models
Validated against 15-minute electricity

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60246	
ID	60246
DOE Building Type	SmallOffice
Num Floors	3
Percentile	87.70 %
Estimated wholesale vs retail cost	$ 9797.07
CO_2 emissions	222052.32 lbs/year
Smart Thermostat - 4F cost savings	$ 1316.61
Smart Thermostat - 8F cost savings	$ 2325.84
TMY->AMY Smart Thermostat - 4F cost savings	$ 204.99
TMY->AMY Smart Thermostat - 8F cost savings	$ 103.41
HVAC Efficiency ECM	$ 1291.79
Gas HVAC ECM	$ 4276.69
Gas Water Heater ECM	$ 725.58
Heat Pump Water Heater ECM	$ 476.95
Insulation ECM	$ 736.27
Infiltration ECM	$ 1577.50
Lighting ECM	$ 2898.95

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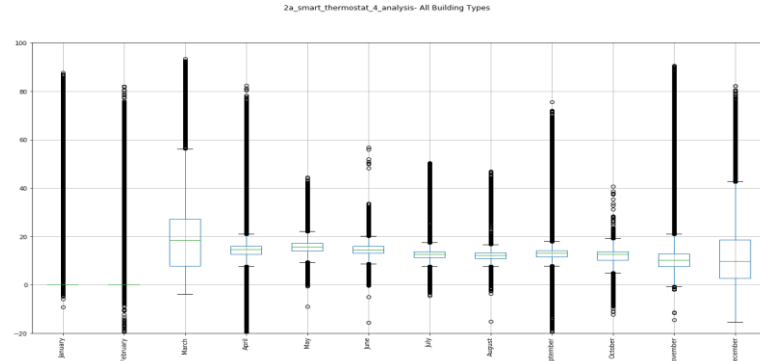Urban building energy sensing, controls, big data analysis, and visualization Workshop '19 | New York, NY | Nov 10, 2019

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2a_smart_thermostat_4_analysis- All Building Types

4°F pre-conditioning shows an average **13%** peak demand reduction across 178,368 residential and commercial buildings.

8°F shows an average **22%,** significant spread.

2a_smart_thermostat_8_analysis- All Building Types

Analysis: Demand Reduction Breakdowns
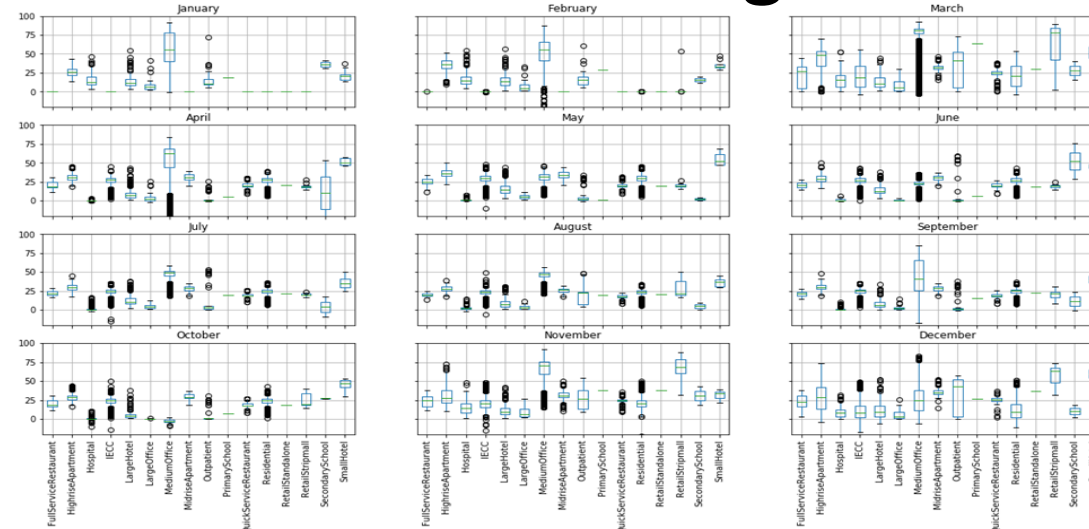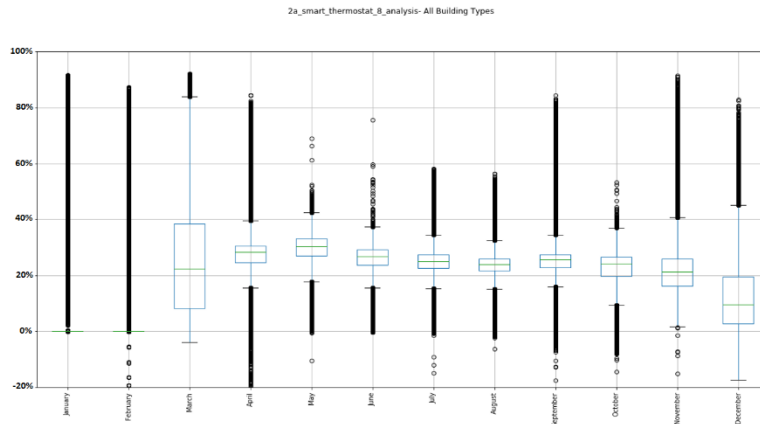
8°F breakdown of quartiles by **building type** for each calendar month with medium offices and strip malls as high, but time-sensitive, value deployments.

8°F breakdown of quartiles by **vintage** (age) for each calendar month shows slight increases with newer vintages.

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