Docket #: S17-505

Data-Driven Urban Energy Benchmarking of Buildings (DUE-B)

Stanford researchers have developed a Data-driven Urban Energy Benchmarking (DUE-B) methodology that uses readily available building energy consumption data to help municipalities design and develop energy efficiency policies and programs. Cities worldwide are mandating energy use data collection in order to pinpoint energy saving opportunities, but municipalities struggle to convert data into actionable insights. Traditional engineering methods (e.g., Energy Plus) are too detailed for benchmarking thousands of buildings across a city, and EPA's?EnergyStar rankings fail to leverage local data streams. Other methods rely on complex machine learning, which reduces interpretability and the ability to shape energy efficiency programs. Stanford's DUE-B is designed to strike a balance between generalizability and interpretability. Using recursive partitioning, DUE-B takes a heterogeneous building dataset, breaks it into comparison groups based on a combination of physical features and energy usage, and benchmarks the performance using stochastic frontier analysis. The result is the ability to benchmark the energy performance of a portfolio of heterogeneous buildings (usually across a city), and identify "inefficient" buildings that can be targeted for incentives and/or retrofits.

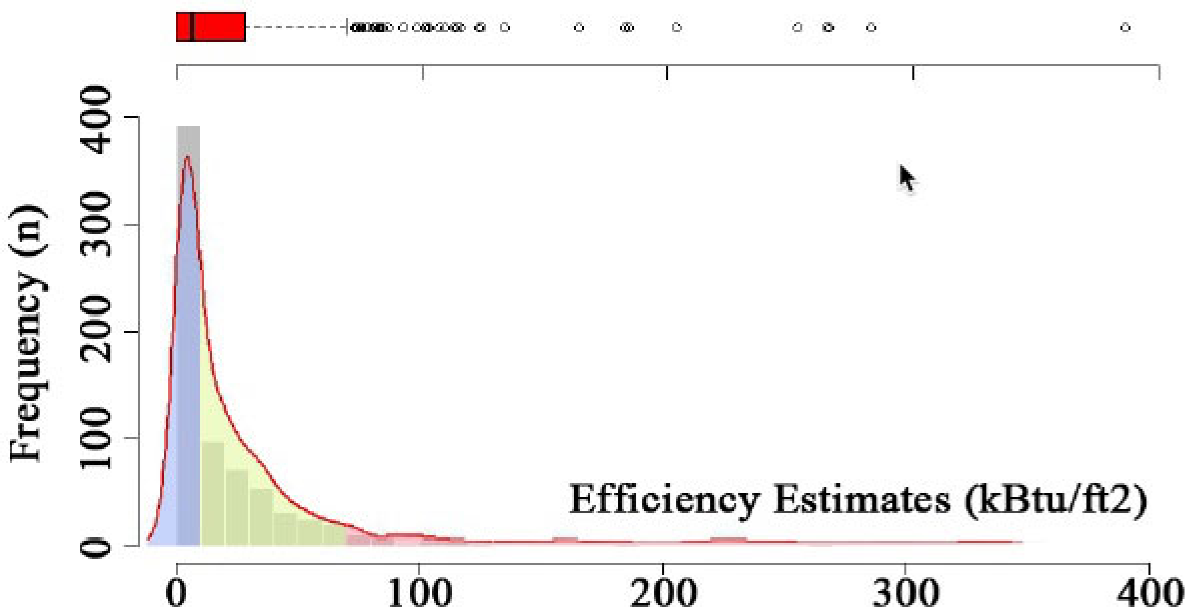

Figure 1. Efficiency Estimates of a 724 Building Subset. The red shaded region (right tail) is the 5% “most inefficient” buildings (n=38), the green shaded region is the 40% “relatively inefficient” buildings (n=292), and the blue shaded region is the 55% “relatively well performing” buildings (n=394).

Stage of Research

Researchers validated the DUE-B method using a dataset of over 10,000 New York City buildings. DUE-B was more robust than other methods (EUI, EnergyStar), and results were easy to interpret. The methodology is more profound with more detailed input data (e.g., HVAC systems, orientation, exterior enclosure, occupancy behavior, etc.). Future work includes collaborating with city officials, buildings managers, and other parties to further assess interpretability, and applicability to design and development of energy efficiency policies and programs.

Applications

- Municipal energy benchmarking and planning

Advantages

- Uses readily available energy consumption data
- Easy to interpret and to differentiate between random factors and inefficiency
- Easier to identify subsets of efficient and inefficient buildings
- Scalable for city wide analysis
- Scalable for deeper analysis as more detailed data is available

Publications

- Yang, Zheng, Jonathan Roth, and Rishee K. Jain. "DUE-B: Data-driven urban energy benchmarking of buildings using recursive partitioning and stochastic frontier analysis." *Energy and Buildings* 163 (2018): 58-69.

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