U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

DOE BUILDINGS PERFORMANCE DATABASE

FUELING INVESTMENT IN ENERGY EFFICIENCY

Overview

CBEA Technical Forum
May 24, 2012

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DOE BPD is a decision-support platform that provides an innovative method for evaluating energy efficiency

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DOE BPD provides…

Empirical Energy Performance Data

- **Empirical, non-synthetic (or modeled) data** from multiple industry sources
- Cleansed, validated, and **stored within a standard taxonomy**

… to value energy efficiency using an…

Actuarial – Based Methodology

- **Portfolio-based risk analysis** methods for evaluating energy use and costs
- Avoids reliance on detailed building by building analysis

… currently implemented within two prototype…

Software Tools for Decision Support

- **Energy Performance Tool** to forecast potential energy savings
- **Financial Risk Management Tool** to forecast cash flows from savings

Actuarial analysis is well established in other domains

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Auto Insurance

- Driver can get a quote over the phone by answering just a few questions about themself and their car.
- Risk analysis and premium determined based on large actuarial data set of driver and car characteristics and claims.
- Does NOT require in-person interview, health check up, car inspection, etc.
- Actuarial analysis allows for a “low-touch, high volume” approach with low transaction costs.

Public Health Studies

Example - Health impacts of smoking.

- Compare group of smokers to a group of non-smokers.
- Large dataset allows for control of other variables (age, gender, health, etc.)
- Usually requires less effort and time than longitudinal approach i.e. Analyze group of smokers over time as they quit smoking.

Actuarial analysis can expand and enhance energy savings analysis in the building sector

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Conventional approach of audits and detailed engineering analysis is costly

- May be justified for large buildings and capital intensive retrofits
- Not cost effective for mid-size and smaller buildings or low-capital retrofits
- Does not leverage benefits of portfolio-based risk management for large portfolios

Actuarial approach has significant benefits for stakeholders dealing with portfolios (utility programs, investment banks, large portfolio owners, etc.)

- Develop savings estimates based on a limited set of building characteristics
  - Much lower transaction costs than conventional approach
  - Uncertainty can be traded off against additional data collection
  - Cross-sectional actuarial approach does not require “pre and post” retrofit data
- Analysis based on actual energy use and buildings characteristics
- Yields uncertainty data to support risk analysis for investment decision-making

BPD's initial implementation supports two market-backed use cases

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Use Case

User: Equity Investor

Use Case: Evaluate the financial risk of investments in energy efficiency measures in different types of commercial buildings.

Use Case

User: Utility; Building Owner/Manager

Use Case: Evaluate the expected energy savings from implementing energy efficiency measures for user-specified commercial and residential buildings, based on real-world data

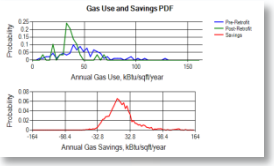
Why is this important?

The financial and building industry does not have a trusted data source to accurately characterize the risk of energy performance in EE investments.

Value of Initial Applications

Financial Risk Management

Translates energy savings estimates from user-defined building types into projected cash flows



Energy Performance Forecasting

Enables users to evaluate the potential energy savings from building retrofit projects using an actuarial-based model

BPD Structure

1. Common taxonomy: a standardized "data model" to organize energy use and building characteristic data
2. Data management: processes and tools to support the on-boarding and validation of data from multiple sources
3. Applications: web-enabled tools to forecast energy savings and related cash flows.
4. 3rd party tool support: API allows 3rd parties to create new applications to use the data in the database

BPD Screen Shots

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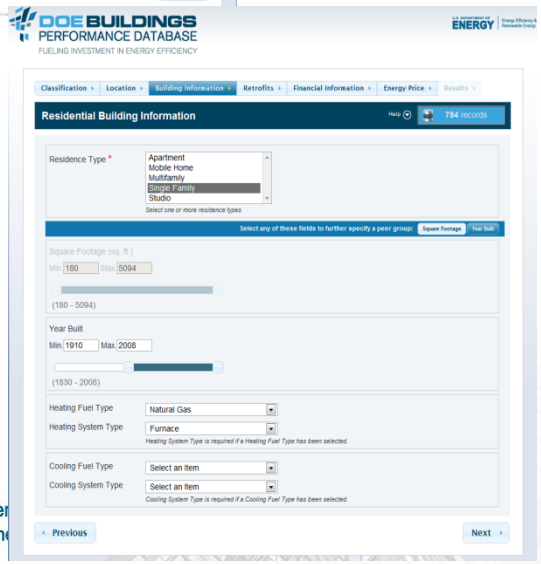
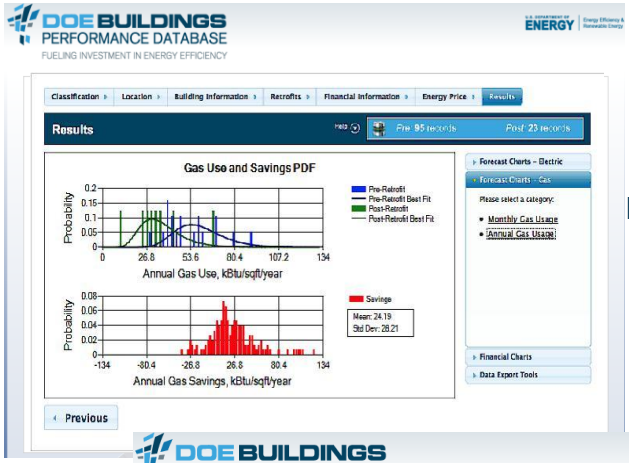
Sample Input Screenshots

1 Building Location Filter

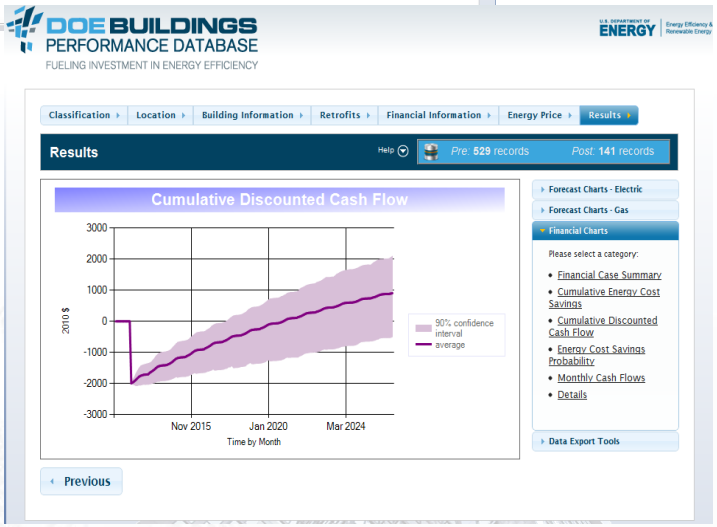


2 Building Characteristics Filters

Sample Output Screenshots



1 Energy Savings Analysis



2 Cumulative Cash Flow Analysis

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Value of Pooling Energy Performance Data

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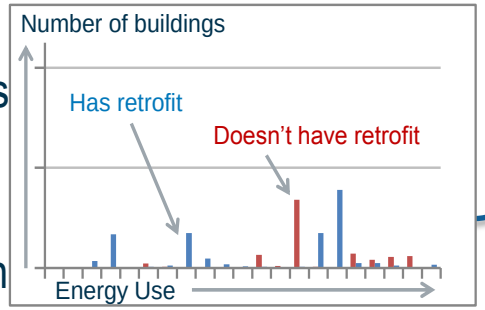
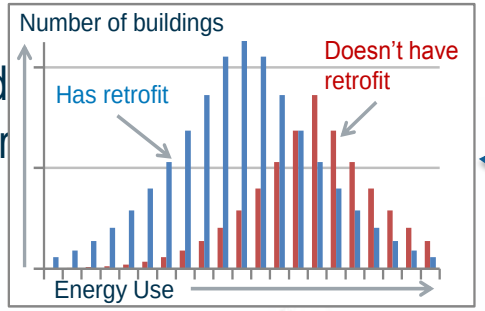
- **Example question:** Should I install energy efficiency measure X in my building?
- **Approach:** Compare buildings with this equipment installed to similar buildings without the efficient equipment
- **Result:** With a few buildings it can be h to tell if there's a clear energy savings in the buildings with the efficient equipment.

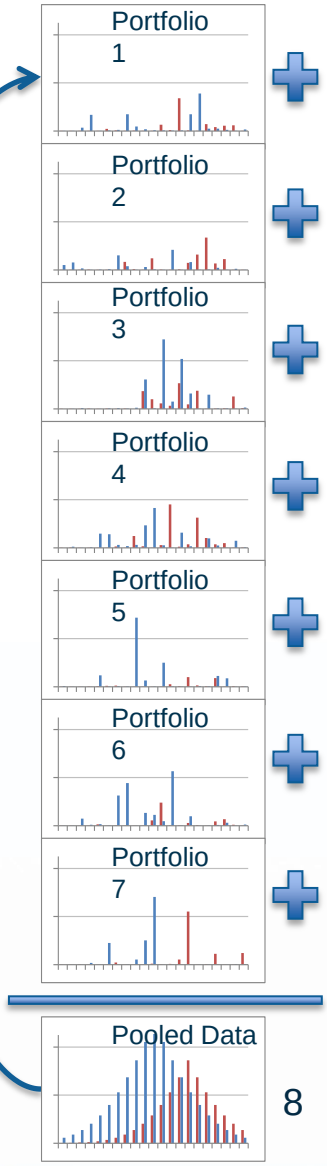


Portfolio of buildings

- **Pooled Data Approach:** With pooled d for may buildings across multiple owner and operators, trends emerge
- **Result:** Expected savings can be calculated much more readily
  - Understand real-world savings
  - Evaluate performance risk
  - Pooled data can remain anonymous



Pooled data from multiple portfolios



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Current priorities reflect market demand and the need to scale

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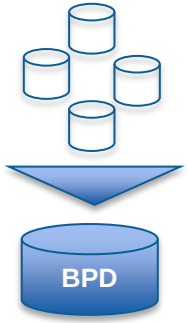
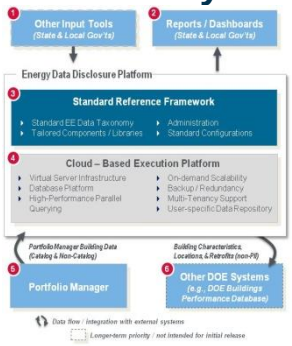
Increase the Size of the Database



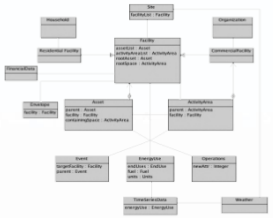
- The database requires more data to reach its full potential
- Targeting data sources with large records and robust data

Expand Platform and Enhance Tool Functionality



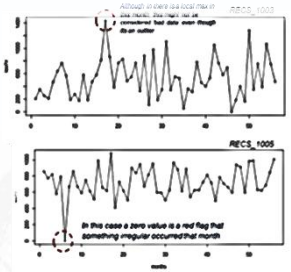
- Improve richness of tools, add new features, strengthen analytics
- Incorporate new industry-defined use cases

Establish Taxonomy as a National Standard



- Publish and disseminate taxonomy
- Conduct broad stakeholder review to continually update the taxonomy

Ensure Data Quality and Consistency



- Automate cleansing of source data
- Develop rigorous validation to enhance confidence in data

For more Information

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We welcome your participation!

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Appendix

Actuarial analysis of energy performance data: Unique opportunity free for CREEA members!

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Opportunity: DOE is offering to help CREEA members apply actuarial data analysis methods on their building energy datasets, leveraging the DOE Building Performance Database (BPD). This analysis can help you:

- *Identify efficiency opportunities and prioritize facilities for efficiency investments*
  - Much lower cost than conventional audits and modeling
  - Better accuracy and granularity than conventional " whole building EUI" benchmarking
- *See financial valuation and cash flow analysis of efficiency investments based on empirical data*
  - Risk analysis based on *empirical,* not modeled, data
  - Provides you an estimate of the uncertainties in savings
  - Extrapolation of results from a sample of retrofitted buildings to a larger population.
  - Batch analysis of portfolio of buildings

Cost: Free for CREEA members.

DOE is also aggregating high-quality empirical data on building characteristics and energy performance to the database from other sources, including utility energy efficiency programs, CBECS , and other DOE programs.

Potential opportunities for utility programs

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DOE BPD can be used to apply actuarial data analysis methods on large pooled datasets. Utilities could use such analyses to:

- *Improve program targeting and market segmentation*
  - Analyze effect of different efficiency measures on actual metered energy use, segmented by building type, location, vintage, etc.
  - BPD analysis results can be used as a benchmark and cross-check for savings projections in different market segments.

- *Inform M&V efforts*
  - Complement existing M&V efforts with results based on *empirical,* not modeled, data
  - Savings uncertainty analysis could potentially be used to fine-tune M&V requirements for different measures and contexts. (e.g. lower uncertainty => simpler M&V)
  - With enough historical data, BPD can analyze persistence in an actuarial manner. (e.g. “How does persistence for a given measure vary based on building type, context, etc.?”)

DOE is aggregating empirical data on building characteristics and energy use from many sources, including large portfolio owners, CBECS, and other DOE programs.

Illustrative example of energy savings distribution: High efficiency furnace retrofits

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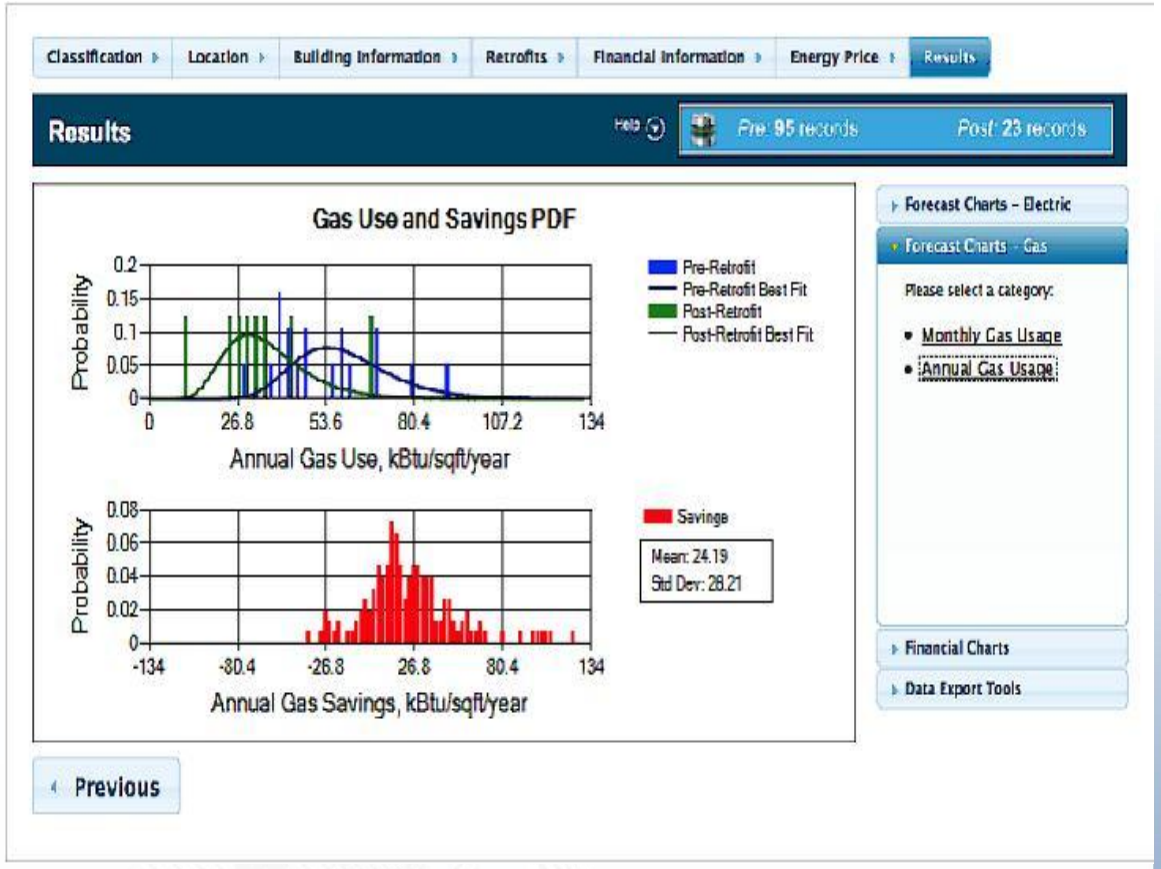
- Baseline EUI distribution based on peer group with the user's building characteristics (size, location, existing furnace efficiency)
- Post-retrofit EUI distribution based on replacement furnace efficiency
- Savings distribution derived from baseline and post-retrofit EUIs
- Analysis reveals range of savings - and therefore potential risk - based <u>exclusively on measured data</u>
- Range can be narrowed by including additional characteristics such as insulation levels, etc.



Illustrative residential sector example with ~120 records

Mean savings of this upgrade = 24 kBtu/sqft/yr

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