Updates to the EPA Rating for Supermarkets

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The EPA Rating

EPA Rating Objectives

- Help businesses protect the environment through superior energy efficiency
- Motivate organizations to develop a strategic approach to energy management
- Convey information about energy performance in a simple metric that can be understood by all levels of the organization

EPA Rating Characteristics

- Monitor actual as-billed energy data
- Create a whole building indicator
  - Capture the interactions of building systems not individual equipment efficiency
  - Track energy use accounting for weather and operational changes over time
- Give a peer group comparison
  - Compare a building's energy performance to its national peer group
  - Track how changes at a building level alter the building's standing relative to its peer group

EPA Rating – Market Penetration

- Over 70,000 buildings rated
  - Includes over 7,000 supermarkets
    - Over 250 million square feet
    - 1,303 Supermarkets labeled ENERGY STAR
  - Other major categories
    - Offices – over 12,500 rated
    - K-12 Schools – over 14,000 rated
    - Retail Stores – over 14,000 rated
    - Hotels – over 3,000 rated

Updating the Rating System

Why do we update?

- Many models still based on data from 1999 or earlier
- EIA released its most recent survey in December of 2006
  - Based on 2003 market data
  - More recent conditions provide greater accuracy for comparison among peers
  - New survey questions on building operation provide better information on key drivers of energy use
- Opportunity to revisit underlying methodology
  - Evaluate alternative statistical techniques
  - Simplify methods for easy replication by users

How does the rating system work?

- Analyze national survey data
  - Commercial Building Energy Consumption Survey (CBECS)
- Develop regression models to predict energy use for specific space types based on operations
- Create scoring lookup table
  - Ratings are based on the distribution of energy performance across commercial buildings
  - One point on the ENERGY STAR scale represents one percentile of buildings
- Buildings that perform in the 75th percentile or better can earn the ENERGY STAR label

How does the rating system work?

- Developing the regression model
  - Account for building operations
    - Walk-in Refrigeration, Employees, Hours, HDD, CDD, etc
  - Apply a linear regression model
    - Energy= C + C_1*Sqft + C_2*Workers + C_3*WalkinRefrigeration + C_4*HDD + C_5*CDD + ...
    - Coefficients represent average responses
    - Coefficients provide adjustments for the operational characteristic
      - ***Does not*** add the kWh of each piece of equipment
      - ***Does*** adjust energy based on correlation between operating characteristic and energy use

How does the rating system work?

- The rating ***does***
  - Evaluate as billed energy use relative to building operations
  - Normalize for operational characteristics
    - Size, Number of employees, Walk-in refrigeration, Climate
  - Depend on a statistically representative sample of the US commercial building population
- The rating ***does not***
  - Attempt to sum the energy use of each piece of equipment
  - Normalize for technology choices or market conditions
    - Type of lighting, energy price
  - Explain how or why a building operates as it does

What did we analyze?

- General EPA Methodology
  - Regression techniques
  - Weather normalization and weather data
  - Model formats

Regression Technique: What did we find?

- Current process
  - Use ordinary least squares regression
- Opportunities for improvements – Alternative econometric techniques
  - Ordinary least squares regression
  - Stochastic frontier analysis
  - Nonparametric data envelopment analysis
- No recommended change
  - Continue to apply ordinary least squares regression
  - Reliable results
  - Easy to understand and replicate

Weather Normalization: What did we find?

- Previous process
  - Step 1: Use 30-year average HDD and CDD in regression equations
  - Step 2: Adjust actual energy use to energy use that would have been experienced under 30 year average conditions
  - Step 3: Rating based on the comparison of the energy use in Steps 1 and 2
- Opportunities for improvement
  - Available data was 30-year average HDD, CDD
  - Prefer to have actual experienced HDD, CDD
  - The Step 2 adjustment is a “Black Box” for users
- Recommend change
  - Obtained superior data source with experienced HDD, CDD
  - Step 1: Use experienced HDD, CDD in regression equations
  - Step 2: Rating based on comparison of as-billed energy use with energy use in Step 1
  - New process eliminates a step and references better data

Model Format: What did we find?

- Current Process
  - Regression dependent variable: “Ln(Source)” – the natural log of Source Energy
- Opportunities for improvement
  - Natural log does not have easy physical interpretation
  - With source energy as the dependent variable, building size is a significant driver
- Recommended change
  - Regression dependent variable: “EUI” – Source Energy Intensity
  - EUI models yield equivalent predictions
  - EUI is a more common unit
  - Easier to discuss two buildings in terms of EUI

General EPA Methodology

- Resources available online
  - www.energystar.gov/benchmark
  - Under “Selected Resources” (right side)
  - Click on “Read Technical Descriptions of Rating Methodology”
  - http://www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager_model_tech_desc

Supermarkets

Supermarkets: Existing Model

- Based on CBECS 1992 and 1995
- Dependent variable: LN(Source Energy)
- Independent variables:
  - Square foot
  - Hours
  - Workers
  - Number of floors
  - Presence of a food preparation area
  - Number of walk-in, open, and closed Refrigeration cases
  - Number of PCs and registers
  - Heating Degree Days and Cooling Degree Days

Supermarkets: Model Revisions

- Revised model will combine CBECS 1999 and 2003 data
- Revised model will be based on EUI
- Independent variables (i.e. operating characteristics) to be included still under analysis
- Goal is to find the combination of statistically significant variables that explain the greatest amount of variation in EUI among supermarkets

Supermarkets: Model Analysis

- Variables likely to be included
- Statistically significant with over 95% confidence

Operating Characteristics	Existing Model	New Model
Gross Floor Area	√	√
Number of Workers on Main Shift	√	√
Number of Walk-in Refrigeration/Freezer Units	√	√
Heating Degree Days	√ (low confidence)	√
Percent Heated	X	√
Cooling Degree Days	√ (low confidence	√
Percent Cooled	X	√

Supermarkets: Item for Discussion

- Notice two new variables
  - Percent of the building that is heated
  - Percent of the building that is cooled
- **What do you think of these variables?**
  - Are they easy to report?
  - What types of spaces in a supermarket are not heated or cooled?
  - Could these percents be reported in bins of 10 (i.e. 10%, 20%, etc)?

Supermarkets: Model Analysis

- Variables under consideration
- Statistically significant with only 80-90% confidence
- Note that in the current model these two variables have relatively low levels of confidence, as well

Operating Characteristics	Existing Model	New Model
Weekly Operating Hours	√ (low confidence)	?
Presence of On-site Cooking	√ (low confidence)	?

Supermarkets: Items for Discussion

- Weekly operating hours
  - Important – captures varying levels of business activity?
  - Not important – most equipment (e.g. refrigeration) operates continuously?

  → ***What do you think?***
- Presence of on-site cooking
  - Important – captures varying levels of business activity?
  - Not Important – current business models all include some form of cooking?
  - Note that 95% of supermarkets in Portfolio Manager have cooking

  → ***What do you think?***

Supermarkets: Model Analysis

- Variables ***NOT*** likely to be included
- Statistically significant with less than 70% confidence

Operating Characteristics	Existing Model	New Model
Number of Registers/PCs	√ **(low confidence)**	**X**
Number of Floors	√	**X**
Number of Open and Closed Refrigeration Units	√	**X**

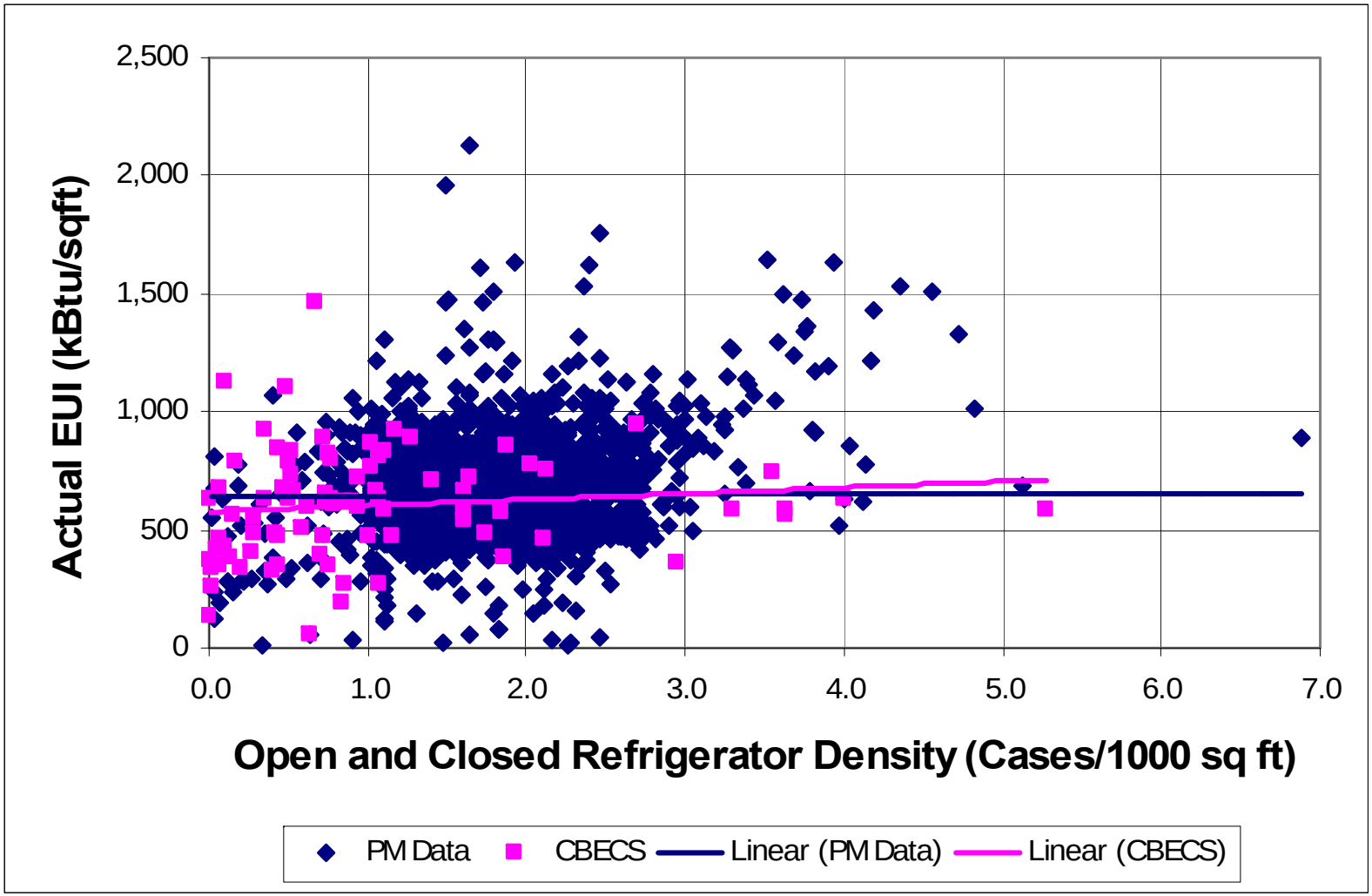
Supermarkets: Model Analysis

- PCs and Registers
  - Not determined to be statistically significant
  - Had low significance in previous model, too
  - These loads are expected to be small in comparison to refrigeration and conditioning loads
- Number of Floors
  - Not determined to be statistically significant
  - Suspect inconsistent reporting, due to mezzanines and partial floors
  - Number of floors generally is not relevant for other commercial building categories
  - At the design phase there is discretion to choose the number of floors
- Based on the analysis EPA does not recommend having these variables in the analysis

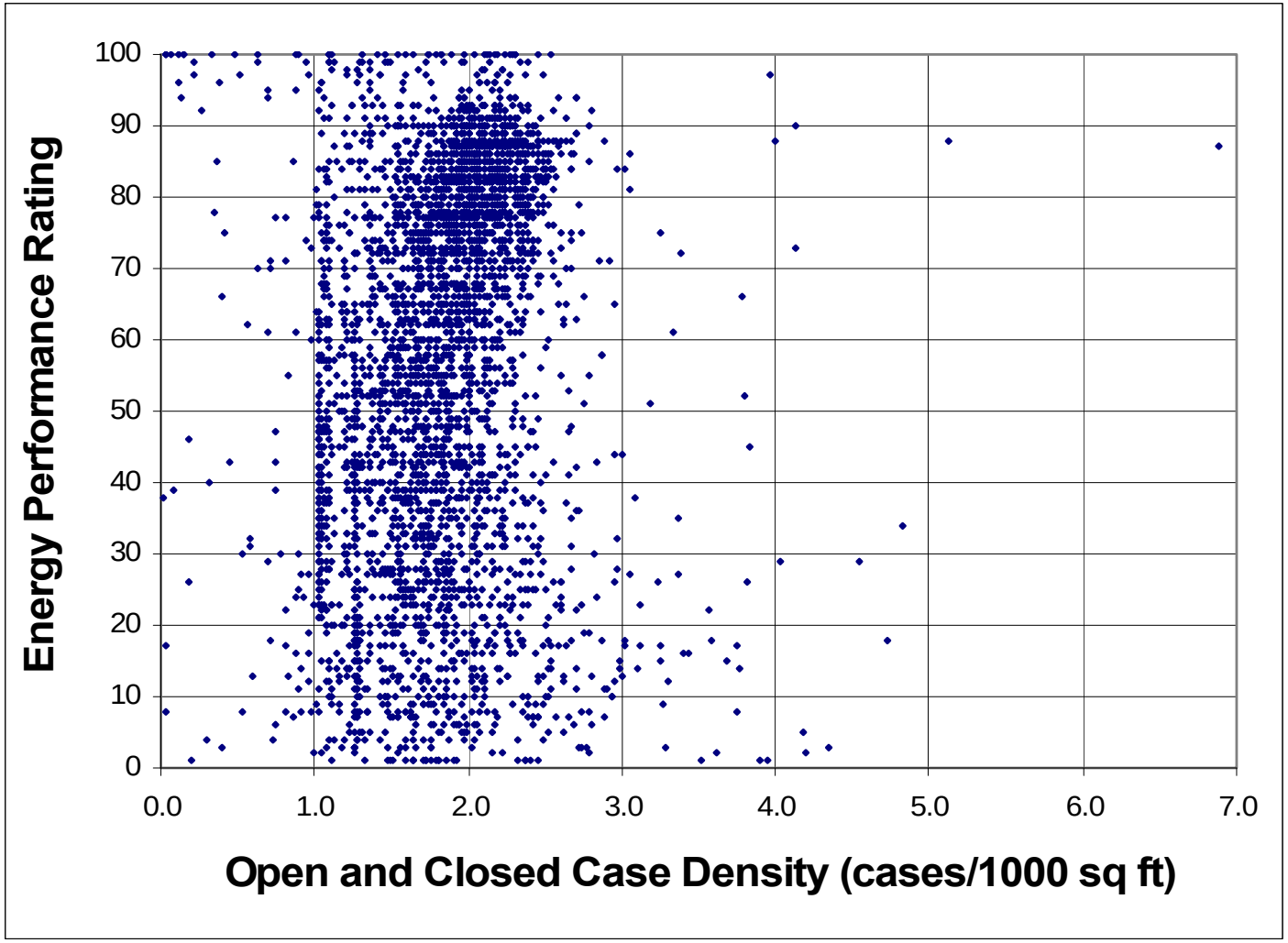
Supermarkets: Model Analysis

- Number of Open and Closed Refrigeration cases
  - Not determined to be statistically significant
  - Graphs of CBECS data and Portfolio Manager data show little correlation with EUI
  - Other model variables (e.g. walk-in units, worker density, floor area) capture the size of the business
    - Number of open and closed units is likely correlated with these measures and does not need to be included separately
- EPA does not recommend including these units

Open and Closed Refrigeration



Open and Closed Refrigeration



Supermarkets: Items for Discussion

- Open and closed refrigeration
  - EPA does not recommend including in the model
- **What do you think about this analysis?**
- **Should EPA continue to record the number of Open and Closed cases in Portfolio Manager?**
  - Already there
  - May be useful for any future analyses and model revisions

Next Steps

Next Steps: What does this mean?

- Revised models will be based on more current data
- Statistical methods will remain equally robust
- EUI format will be easier to understand for all levels of an organization
- New set of independent variables will provide superior adjustments for building operation

Next Steps: How will ratings change?

- Ratings are likely to change!
- Exact details of changes are still to be determined
  - Need to finalize model
- All changes reflect
  - Improvements to EPA's overall methodology
  - More current market data
- Revised model will provide a more accurate assessment of performance
- Rating changes will be experienced in both baseline and current ratings
  - Portfolio Manager will still capture your past improvements

Next Steps: Timeline

- Collect additional feedback, if necessary
  - Please send comments to Brian Carroll BCarroll@icfi.com by ***COB, March 7***
- Make final model decisions
  - Consider your feedback
  - Perform additional review of CBECS data
  - Evaluate models using Portfolio Manager data
- Communicate final decisions and outcomes
  - Individually call each focus group participant prior to model release to discuss outcomes/ rating changes
- ***Schedule: Release new supermarket model in July 2008!***

Questions?

For questions/ concerns or to send feedback,

please contact Brian Carroll at BCarroll@icfi.com