

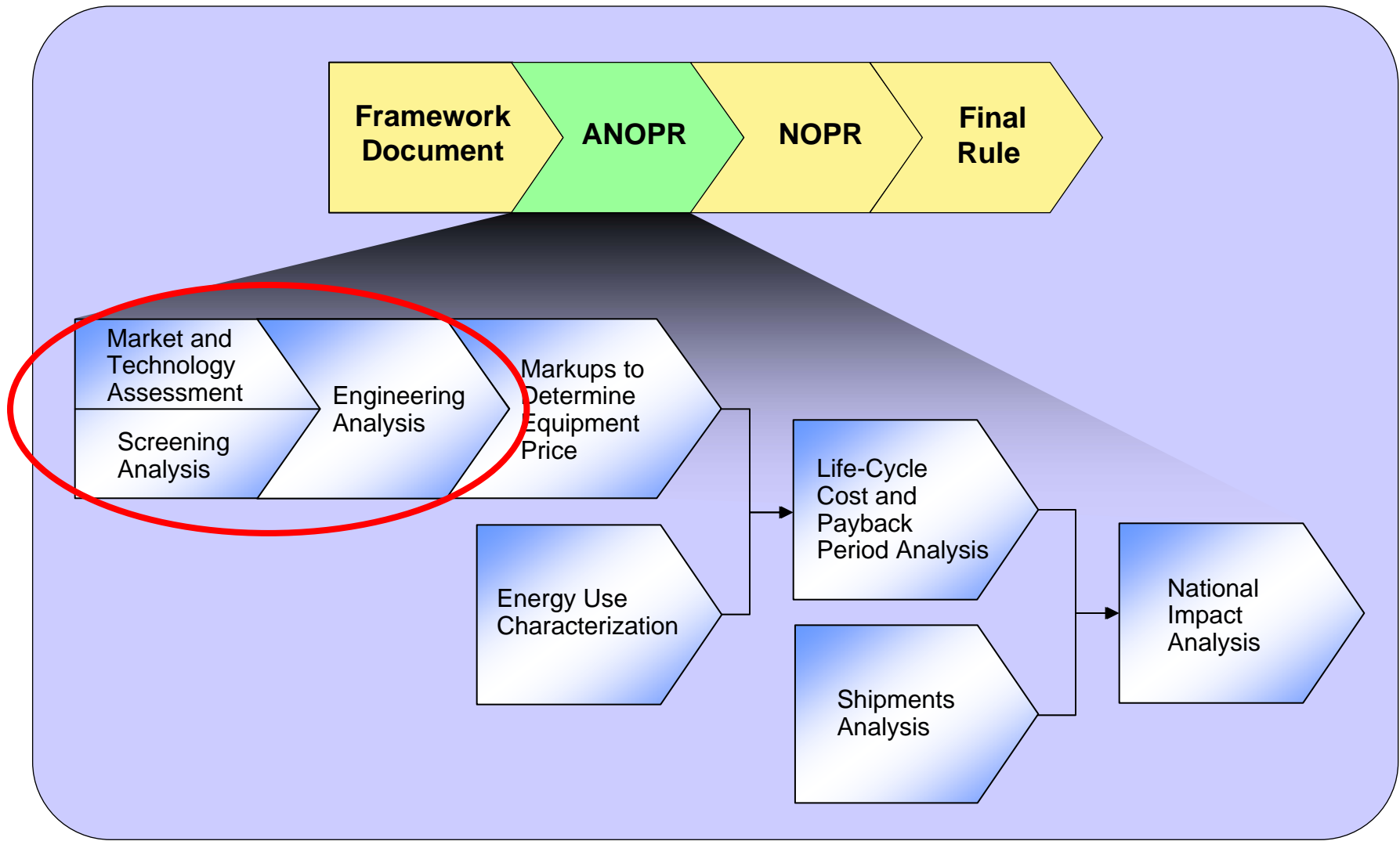


U.S. Department of Energy  
Energy Efficiency and Renewable Energy

# Engineering Analysis



# ANOPR Analyses Flow Diagram





## Purpose

### ■ Market & Technology Assessment

- To characterize the beverage vending machine market to determine available equipment efficiencies and shipments by equipment class

### ■ Screening Analysis

- To identify design options that increase efficiency and to apply screening criteria established by DOE to determine which design options to evaluate and which to screen out

### ■ Engineering Analysis

- To characterize manufacturer cost-efficiency relationships for higher efficiency equipment
- To evaluate design options that improve efficiency relative to the baseline units
- Sensitivity analyses



## Market Shares and Unit Shipments

- Three manufacturers account for approximately 75% of the domestic market share of all types of covered equipment.
  - Crane Merchandising/Dixie-Narco, Inc.
  - Royal Venders, Inc.
  - Sanden-Vendo America
  
- Installed base of approximately 3,700,000 units.\*
  
- Approximately 340,000 units are shipped annually.\*

\* Automatic Merchandiser, State of the Vending Industry Report (August 2006).



## Screening Analysis Method

- **Design options screened using the following criteria:**
  - Technological feasibility
  - Practicability to manufacture, install and service
  - Adverse impacts on product utility or product availability
  - Adverse impacts on health or safety



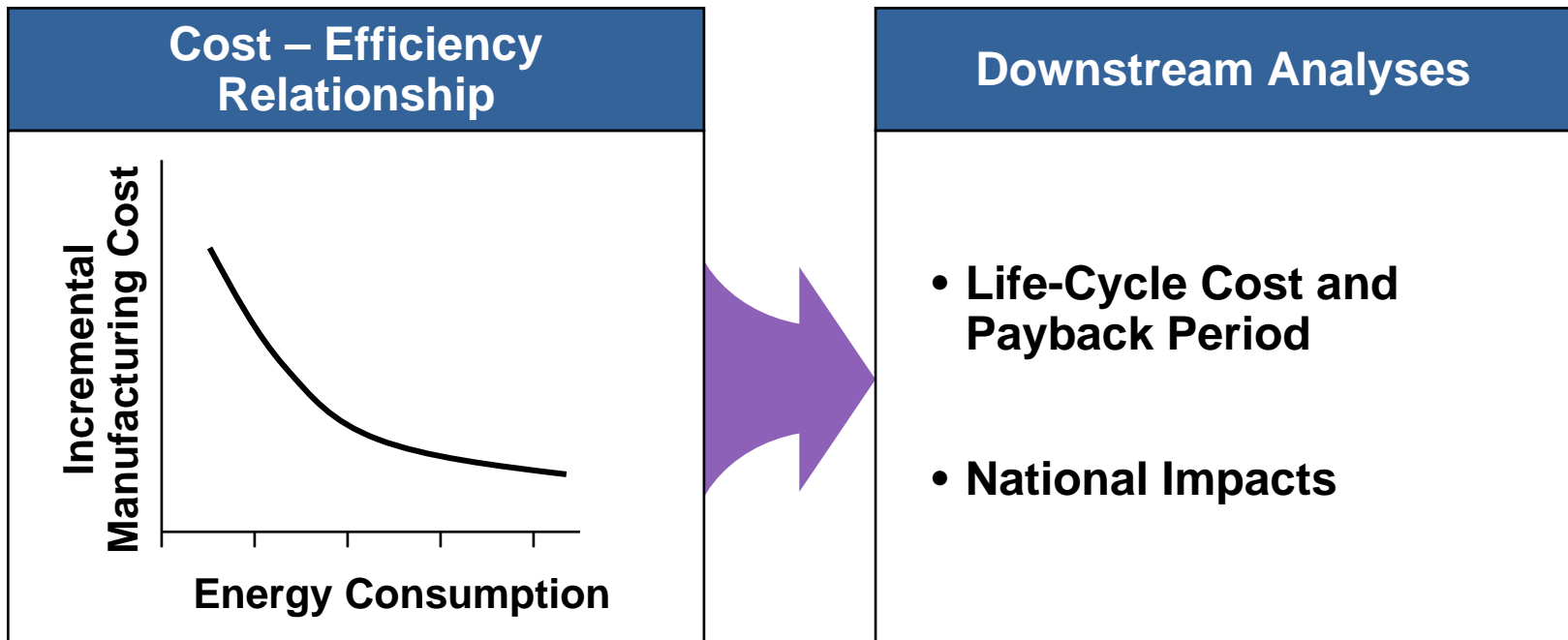
## Technologies Selected for Further Consideration

<b>Technologies that can improve CDEC</b>
<ul style="list-style-type: none"><li>• higher efficiency lighting and ballasts</li></ul>
<ul style="list-style-type: none"><li>• higher efficiency evaporator fan motors</li></ul>
<ul style="list-style-type: none"><li>• evaporator fan motor controllers</li></ul>
<ul style="list-style-type: none"><li>• improved evaporator design</li></ul>
<ul style="list-style-type: none"><li>• insulation improvements or thickness increases</li></ul>
<ul style="list-style-type: none"><li>• improved glass pack (for Class A machines only)</li></ul>
<ul style="list-style-type: none"><li>• higher efficiency condenser fan motors</li></ul>
<ul style="list-style-type: none"><li>• improved condenser design</li></ul>
<ul style="list-style-type: none"><li>• higher efficiency compressors</li></ul>



## Purpose of the Engineering Analysis

- Characterize the relationship between manufacturer cost and efficiency (or energy consumption)





## Engineering Analysis Method

### ■ Equipment classes analyzed

- DOE selected two equipment classes for its analyses:
  - Class A (fully-cooled machines)
  - Class B (any machine not considered to be Class A)
- DOE analyzed three different size beverage vending machines for each equipment class:
  - Small
  - Medium
  - Large

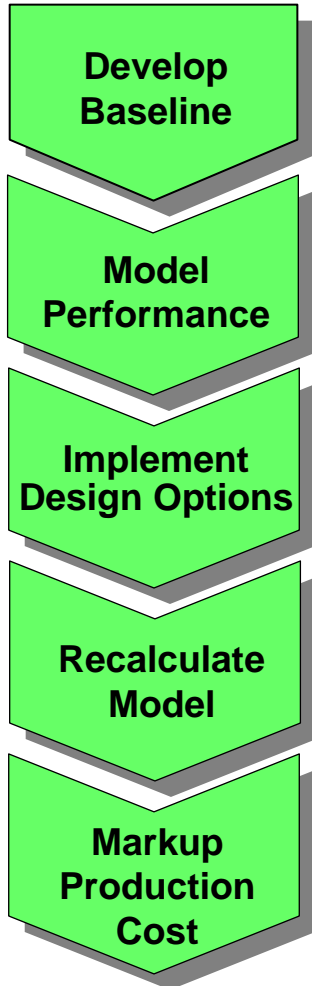


### ■ Design-option approach

- DOE analytically derived cost-efficiency curves
- Used to supplement and validate the industry data



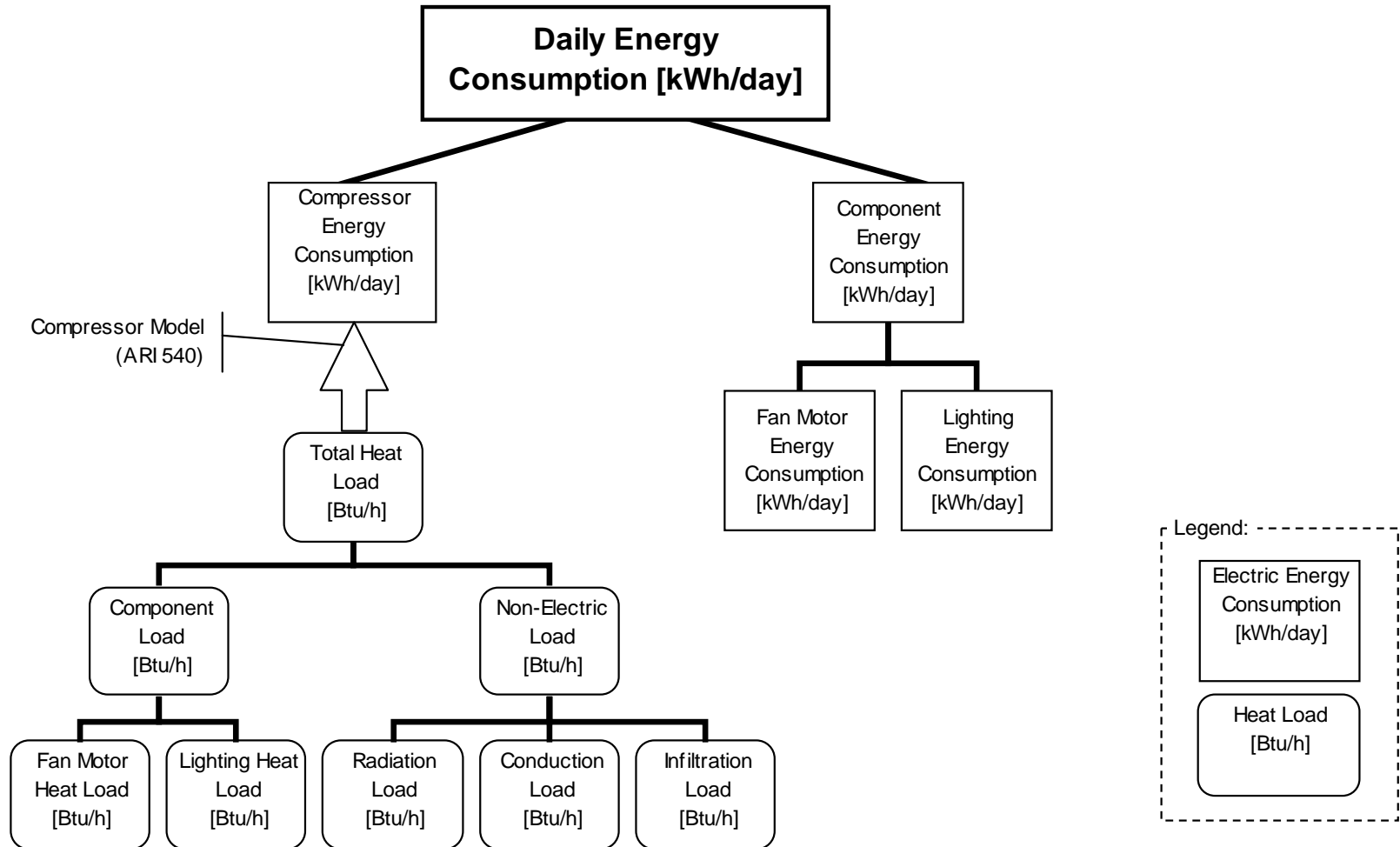
## Design-Option Approach



- Define baseline specifications for each equipment class
- Model the manufacturer production cost (MPC) and energy consumption (CDEC) of the baseline units
- Implement design options one-by-one in order of shortest payback to longest payback
- Add the incremental cost of each design options to the baseline and recalculate CDEC with design options in place
- Markup the MPC to manufacturer selling price using manufacturer markup



# Energy Consumption Model





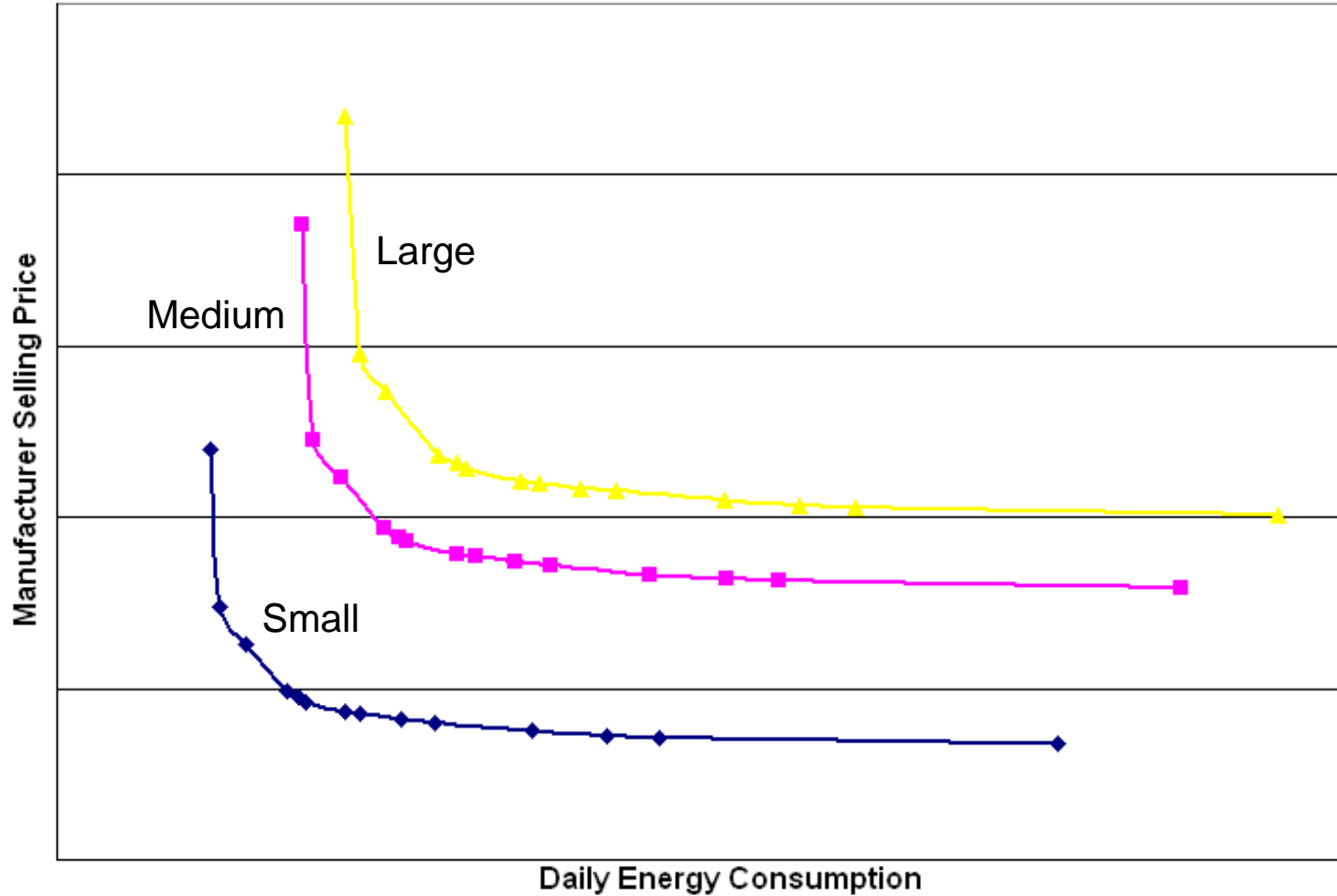
## Cost Model

- **Cost model adopted from DOE's rulemaking for commercial refrigeration equipment, due to similarities in manufacturing processes between self-contained commercial refrigeration equipment and vending machines.**



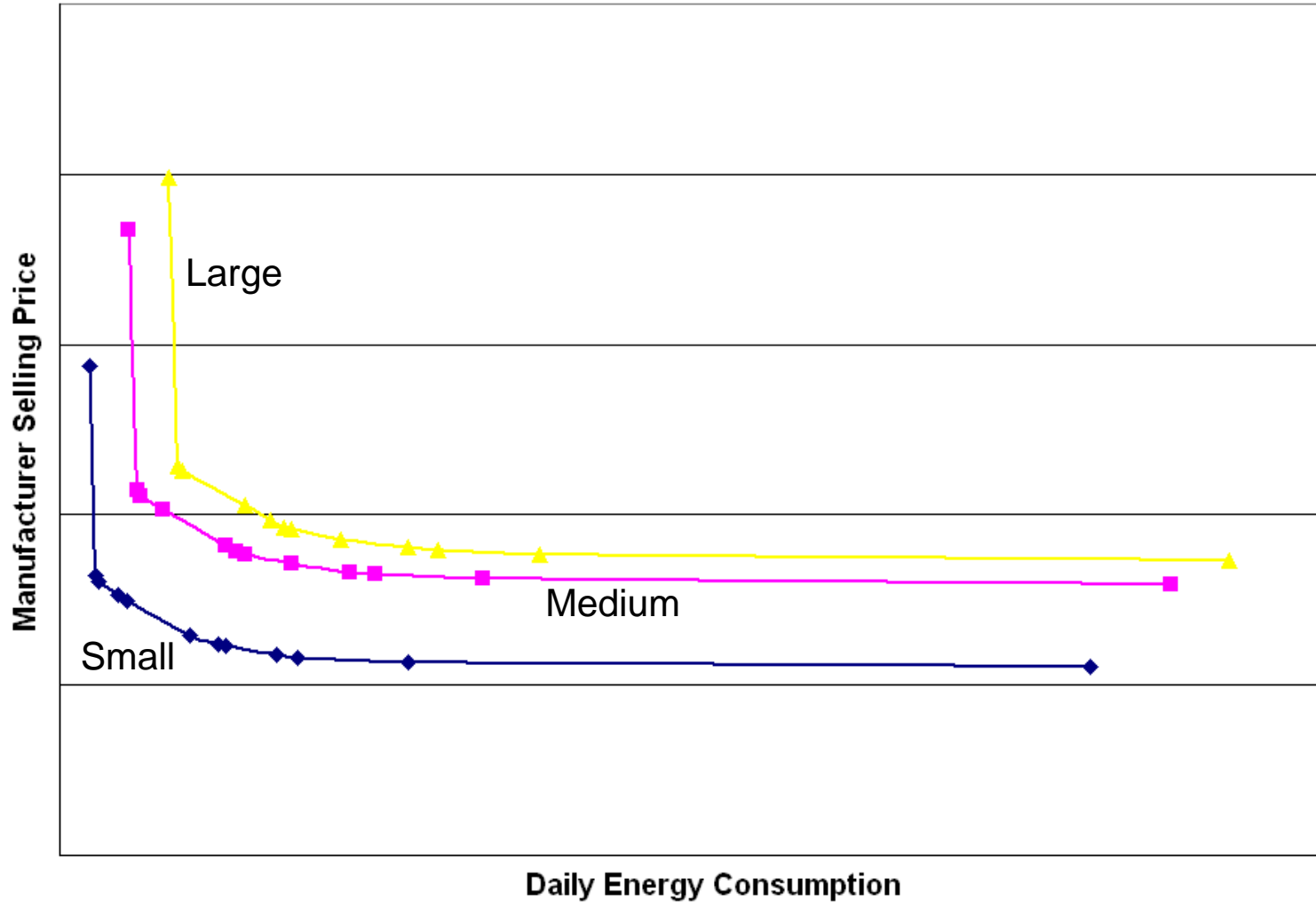


# Results for Class A





# Results for Class B





## Other Issues

*DOE invites comments and recommendations from stakeholders on any other aspects related to the engineering analysis.*