CHAPTER 13. MANUFACTURER IMPACT ANALYSIS

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CHAPTER 13. MANUFACTURER IMPACT ANALYSIS

13.1 INTRODUCTION

The Manufacturer Impact Analysis (MIA) assesses the financial and employment impacts of proposed new standards for water heater energy efficiency.

The financial analysis is based on expected future cash flows, a method commonly used as the basis for business decisions. We use an annual cash flow analysis to measure the acceptability of a potential investment by determining a total present value of future cash flows, implicitly including the cost of capital.

Adoption of any energy-efficiency standard requiring major changes to water heater manufacturing practices may also affect:

- Future viability of manufacturers
- Employment levels
- Product pricing

Proposed energy-efficiency standards are one of several regulations facing the water heater industry. Water heater manufacturers currently face government actions eliminating HCFCs as a blowing agent for foam insulation and tests requiring the production of a flammable-vapor ignition-resistant gas-fired water heater. Manufacturers believe the overall impact of these regulations, including energy-efficiency standards, could be significant given limited resources and overlapping schedules for meeting these new regulations.

13.2 MANUFACTURER IMPACT ANALYSIS METHODOLOGY

The MIA was conducted in four phases. Phase 1, Industry Profile and Issue Definition, consisted of two activities: characterizing the industry and conducting issue identification interviews. The second phase, Generic Industry Cash Flow, used the Government Regulatory Impact Model (GRIM) to prepare a “generic” industry cash flow analysis. During the second phase, DOE used publicly available information developed in Phase 1 and the data provided by manufacturers to the rulemaking process to adapt the GRIM for analysis of new standards. In Phase 3, Manufacturer Interview Process, the "generic" cash flow was used to discuss with individual manufacturers the impact of proposed standards on industry cash flows. Phase 3 also entailed documenting additional impacts on employment and manufacturing capacity through the interview process. Finally in Phase 4, Industry Cash Flow, information from the interview process was aggregated with data from the Gas Appliance Manufacturers Association (GAMA) to develop an industry cash flow.

13.2.1 Phase 1: Industry Profile and Issue Identification

Prior to initiating the detailed impact studies, DOE received input on the present and past structure and market characteristics of the water heater industry. This activity involved both quantitative and qualitative efforts to assess the industry and the products to be analyzed. Issues addressed included manufacturer market shares and characteristics, trends in number of firms, the financial situations of manufacturers, and trends in water heater characteristics and markets.

To further assist in profiling the industry and defining key issues, DOE conducted a series of interviews with water heater manufacturers in late 1997. The interviews and review of public literature suggested the following:

- The analysis should recognize the increasingly competitive nature of the water heater industry.
- The MIA should include consideration of impacts of other regulatory requirements facing water heater manufacturers. DOE recognized that manufacturers are facing significant changes related to the phase-out of HCFC refrigerants and the voluntary adoption of flammable-vapor ignition-resistant gas-fired water heaters.

13.2.2 Phase 2: "Generic" Industry Cash Flow Analysis

For the "generic" industry cash flow analysis, DOE prepared a list of financial values to be used in the GRIM industry analysis. These were derived from publicly available financial information concerning the water heater industry. (A detailed definition of financial inputs and their values for a "generic" water heater manufacturer was presented in "Financial Inputs to GRIM for the Water Heaters Rulemaking Analysis," which was presented at a public workshop held in November 1998.) Manufacturing costs—labor, materials, depreciation/tooling, etc.—were obtained from GAMA data. For the "generic" industry cash flow analysis, DOE used the shipment scenarios developed in the Shipments Analysis (see Chapter 11).

The "generic" industry cash flow was used to provide a starting point from which manufacturers could develop more recent and accurate inputs. "Placeholder" values were used to illustrate the workings of the GRIM spreadsheet and to elicit more information from manufacturers on modeling inputs.

13.2.3 Phase 3: Manufacturer Interview Process

DOE conducted detailed interviews with water heater manufacturers in February and March 1999. During these interviews, information was solicited to evaluate cash flows and assess employment and capacity impacts of proposed energy-efficiency standards.

The interview process gave manufacturers an opportunity to privately express their views and to provide confidential information for assessing financial, employment, and other business impacts of standards. To support the development of cash flows, an interview guide

requested information on the possible impacts of new standards on manufacturing costs, product prices, and sales. Evaluation of the possible impacts on direct employment and manufacturing assets of standards also drew heavily on interview information. The interview guide solicited both qualitative and quantitative information. Supporting information was requested whenever applicable.

13.2.4 Phase 4: Industry Cash Flow Analysis

During the interview process, the results of the "generic" cash flow analysis were discussed with the manufacturers. In many cases, manufacturers felt the "generic" analysis closely represented the industry as a whole and their firms in particular. When manufacturers differed from the "generic," the financial inputs were adjusted to account for these differences. Generally, manufacturers agreed closely on the overall impact of proposed standards. The analysis discussed in this chapter is based on the financial inputs provided by manufacturers.

13.3 MANUFACTURING IMPACT ANALYSIS RESULTS

13.3.1 Industry Profile

An initial industry characterization relied on information from relevant industry and market publications, industry trade organizations, company financial reports, and product literature. This industry characterization report helped in developing the "generic" industry cash flow analysis and also in the development of a detailed and focused interview guide to perform the MIA. Historical shipment information was obtained from publicly available *Current Industrial Reports* (CIRs) published by the U.S. Census Bureau. Financial and cost information was obtained from the *Census of Manufactures* (another Census Bureau publication), SEC 10-K statements, and Dun & Bradstreet reports.

13.3.1.1 Current Manufacturer Market Shares and Characteristics

Table 13.1 lists the major water heater manufacturers and their characteristics. Figure 13.1 shows market share by manufacturer. Manufacturer interviews and plant visits were conducted between October and December 1997; additional interviews occurred in February and March 1999.

Table 13.1 List of Water Heater Manufacturers

Manufacturer	Characteristics
American Water Heater Company	A subsidiary of Southcorp, an Australian holding company, American produces mostly residential and some commercial water heaters in its Johnson City, TN facility and sells in the wholesale and retail channels. The parent company owns the largest manufacturer of water heaters in Australia and also manufactures water heaters in New Zealand and China.
A.O. Smith	The largest manufacturer of commercial water heaters, A.O. Smith also produces residential units. Its water systems technology division manu-factures in the US, Canada, Mexico, the Netherlands, and China. A.O. Smith only sells through the wholesale channel.
Bradford White	Producer of commercial and residential gas-fired and electric water heaters and residential oil-fired water heaters. Bradford White's primary manufacturing facility is in Middleville, MI. Bradford White sells only through the wholesale channel.
Rheem	Second largest manufacturer of residential and number two producer of commercial water heaters, Rheem produces residential products in Mexico although its largest facility is still in Montgomery, AL. Subsidiary Water Heater Innovations manufactures the Marathon plastic tank electric water heaters. Rheem sells in the wholesale and retail channels.
State Industries	State is estimated to be the largest manufacturer of residential water heaters. It has production facilities in Ashland City, TN, with components manufacturing in Franklin, TN. State sells through the wholesale and retail channel.
Bock Water Heaters	Located in Madison, WI, Bock is one of the largest oil water heater manufacturers in the US. Bock also manufactures indirect water heaters.
Vaughn	Vaughn manufactures stone-lined electric water heaters in its Salisbury, MA plant. Vaughn products are sold mainly on their long life and the load controls attached to each tank.
Heat Transfer Products	Based in East Freetown, MA, Heat Transfer Products manufactures commercial gas-fired water heaters, residential and commercial electric and oil water heaters, as well as marine and indirect water heaters and copper coil heat exchangers.

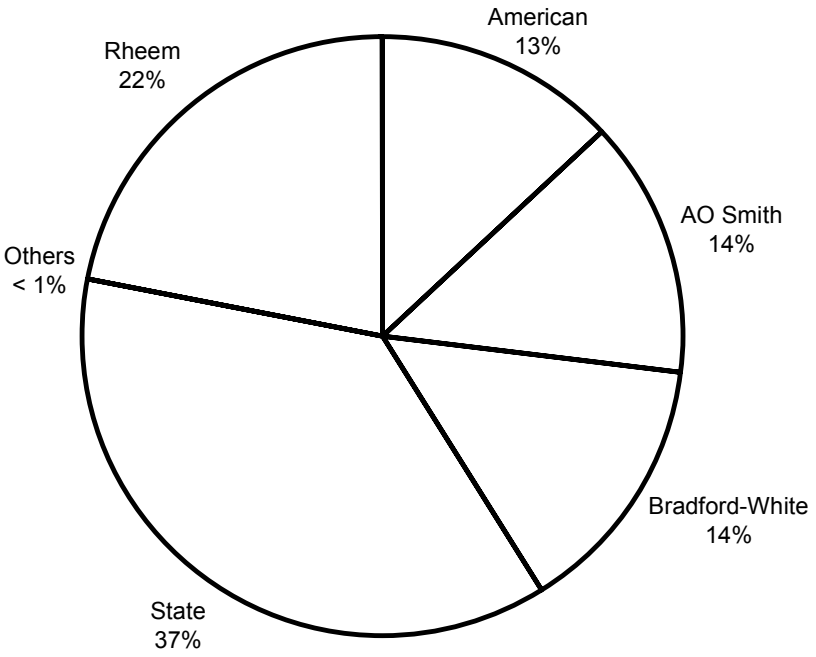


Figure 13.1 Residential Water Heater Market Shares

The interviews conducted in 1997 and 1999 produced a number of characteristics that could be used to define sub-groups; these included product mix, company size, location of production facilities, and level of vertical integration. For purposes of the MIA, manufacturers were grouped by product mix. This aggregation scheme was chosen as the most comprehensive way to report the variation of energy-efficiency standard's impacts on different manufacturers while ensuring confidentiality for individual manufacturers. Based on information presented in Table 13.1, manufacturers were divided into the two sub-groups shown in Table 13.2.

Table 13.2 Manufacturer Sub-groups

Sub-group 1: Large Manufacturers Manufacturers of both electric and gas-fired [a] water heaters	**Sub-group 2: Small Manufacturers** Manufacturers that produce oil-fired water heaters and produce less than 1% of residential electric and gas-fired water heaters (List is representative, not inclusive).
• Rheem • American • State • Bradford White • A.O. Smith	• Bock • Heat Transfer • Vaughn

[a] Water heaters fueled by natural gas and LPG are considered as one product class from the point of view of physical and efficiency characteristics. They are treated separately with respect to manufacturing cost, markup, retail price, and fuel price in the Life-Cycle Cost and subsequent analyses.

The majority of the MIA discussion focuses on the entire industry, which is dominated by sub-group 1. All cash flow impacts presented in this report are representative of the five large manufacturers. Small manufacturers of water heaters in the United States concentrate on niche products, such as electric only, solar, oil-fired, indirect, or marine systems, all estimated at less than 1% of water heaters sold. These manufacturers typically rely on different distribution channels than sub-group 1 manufacturers. No cash flow impacts were calculated for sub-group 2 because they chose not to participate in the financial analysis interviews. Expected impacts on sub-group 2 are discussed in section 13.3.6.

13.3.1.2 Industry Shipments

Current Industrial Reports (CIRs), published by the U.S. Census Bureau, provide detailed data on quantity and total value of U.S. shipments of water heater products. The census bureau uses SIC codes 36391 and 36392 to describe the water heater industry. According to CIR data, 9.0 million residential water heaters, valued at $1.4 billion, were shipped in 1998. Figure 13.2 presents the trend in dollar value of manufacturers' shipments of household water heaters for the period 1990 to 1998. Also, Table 13.3 shows the shipments and value of the household water heaters in 1998.

Shipments of oil-fired water heaters are not available from the CIR. Industry sources estimate that approximately 40,000 to 60,000 oil-fired water heaters are shipped each year.

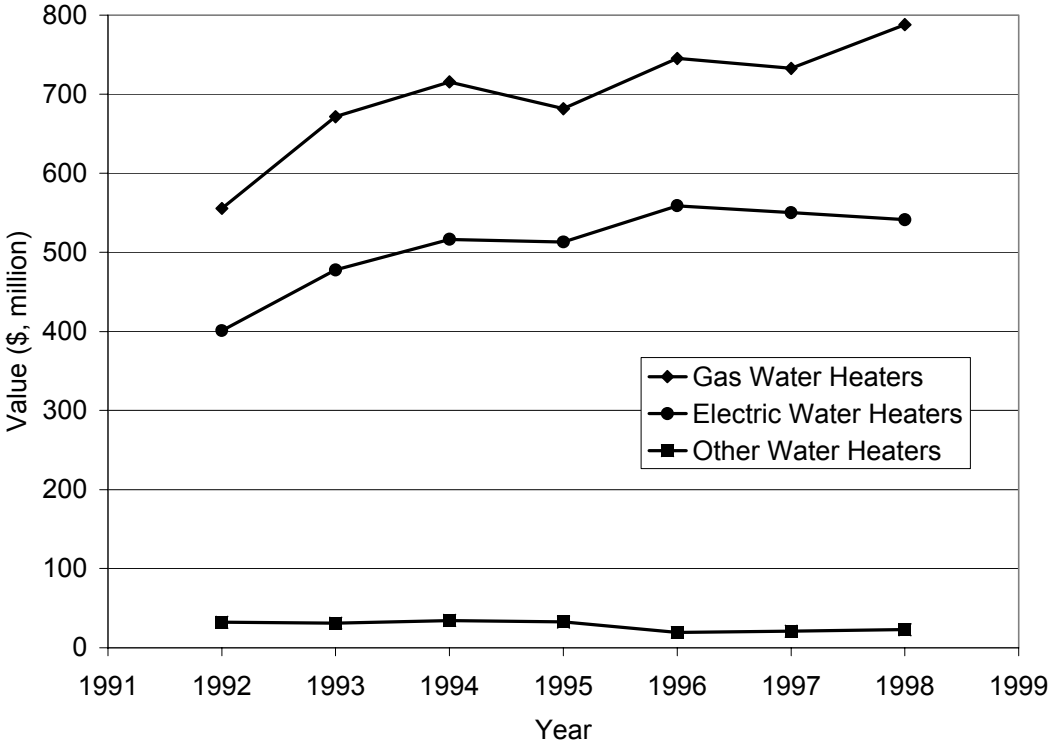


Figure 13.2 Historical Trends in Value of Water Heater Shipments

Table 13.3 Shipments and Value of Household Water Heaters in 1998

Product	Shipments (thousands)	Value of Shipments ($ million)	% of Revenues of all Water Heaters	1998 Cost to the Dealer/ Distributor ($ per unit)
Electric: Storage	4,171	541	40	129.79
Gas	4,737	788	58	166.34
Oil	n/a	n/a	n/a	n/a
Other	113.6	22.8	2	200.70
Total	9,021	1,352		

Source: U.S. Census Bureau

Average revenue per water heater is shown in Figure 13.3. The revenue for electrical units and gas units has been relatively flat since 1992. Manufacturers estimate that 80 to 90 percent of water heaters currently purchased are replacements. Estimated market share of sales of residential water heaters by outlet are shown in Figure 13.4. For the past decade, the overall volume of water heaters distributed through the wholesale channel has been relatively flat. During the same period,

large retailers increased their volumes by 50%. This phenomenon has had two significant financial impacts on water heater manufacturers:

- Margins tend to be lower for water heaters distributed through the retail channel compared to those sold through the wholesale channel.
- Large retailers offer customers money-back guarantees and charge the manufacturer for returned goods whether the water heater had a manufacturing defect or not. This has caused warranty costs in the retail channel to be higher than those in the wholesale channel.

These two phenomena have created an environment of aggressive pricing and increased warranty costs. The growth of the retail water heater market has affected the profitability of all water heater manufacturers.

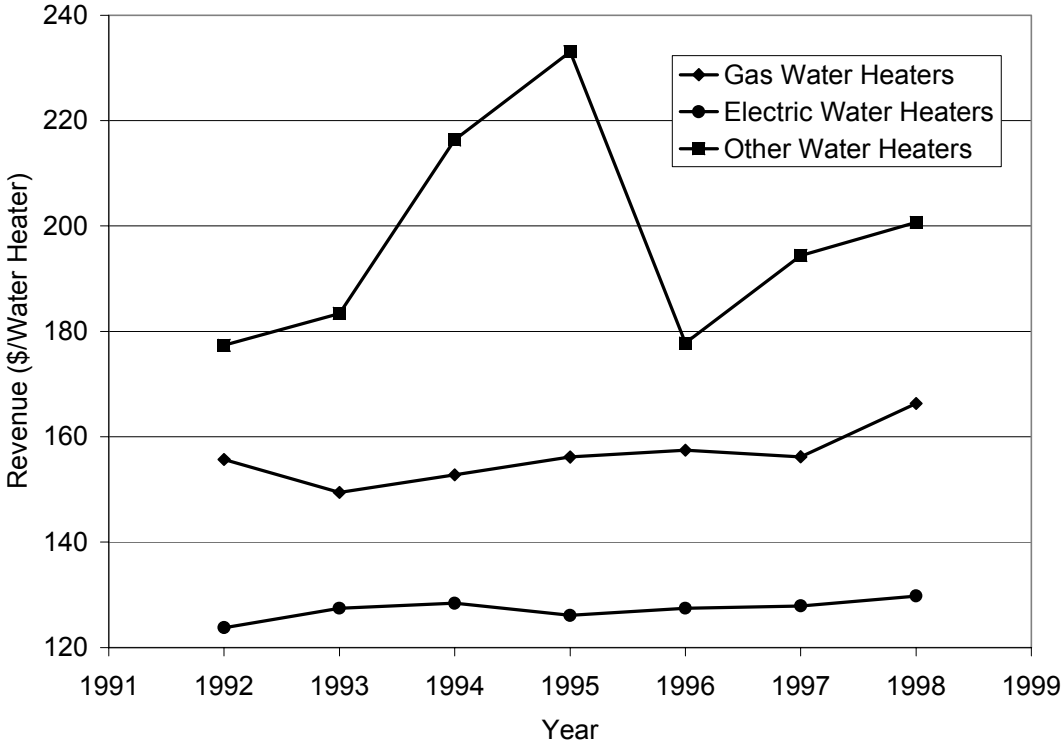
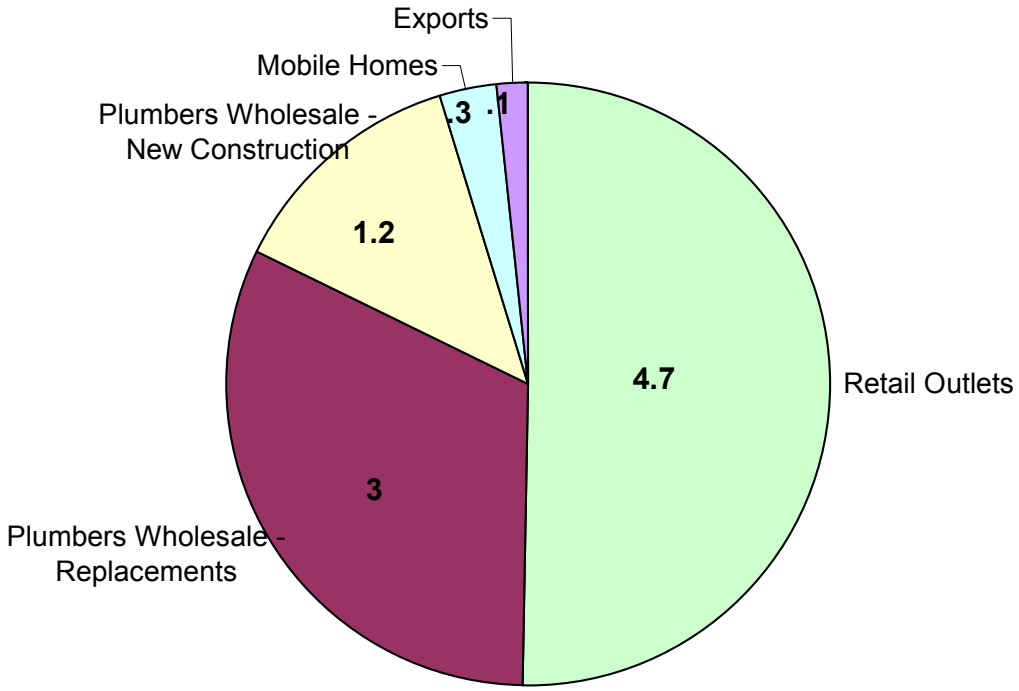


Figure 13.3 Historic Revenue per Water Heater



Source: ADL, Inc. estimates, 1998

Figure 13.4 Shares of Water Heaters Sold by Outlets for 1997 (millions)

Most water heaters purchased for new construction and the majority of water heaters purchased by contractors for replacement are baseline units. Profit margins for baseline water heaters tend to be much smaller than for upscale units. Manufacturers state increasing energy-efficiency standards will significantly reduce their ability to "up-sell," which will lower profitability and/or increase baseline costs. As the relatively large percentage of sales through retailers might indicate, contractors are purchasing from these suppliers (versus plumbing wholesalers) in significant numbers, which has made prices nearly equal between the two channels, because wholesalers must compete with retail outlets for water heater sales.

13.3.2 Manufacturer Impact Analysis Interviews

Visits and preliminary interviews with representatives of eight water heater manufacturers occurred during the fall of 1997 for this analysis. The following manufacturers were included in this series of preliminary interviews:

- American Water Heating Group, Johnson City, TN
- A.O. Smith, McBee, SC
- Bradford White, Middleville, MI
- Bock, Madison, WI
- Heat Transfer Products, East Freetown, MA
- Rheem, Montgomery, AL
- State Industries, Ashland City, TN
- Vaughn Manufacturing, Salisbury, MA

Interviews included open-ended discussions based on the items outlined in the interview guide. General consensus was that the most important change affecting the water heater industry will be new regulations set to take effect during the next five years.

A second round of interviews was conducted concerning the cash flow analysis during February-March 1999. All of the manufacturers in the earlier interviews were contacted and the following manufacturers participated in these second-round interviews:

- American Water Heating Group, Johnson City, TN
- A.O. Smith, McBee, SC
- Bradford White, Middleville, MI
- Rheem, Montgomery, AL

A copy of the *Manufacturers Interview Guide* is included as Appendix H-1. During this interview, manufacturers were asked to comment on the "generic" industry cash flow as well as to provide any additional cost data for the various proposed trial standard levels. Based on these comments, the financial assumptions to the GRIM were adjusted.

During the interviews, water heater manufacturers repeatedly mentioned two potentially costly new regulations. These are:

- Flammable-vapor ignition prevention and
- Phase-out of HCFC-141b as a blowing agent for polyurethane foam insulation

Technical issues and the costs associated with these regulations are discussed in Chapters 3 and 8. This chapter presents comments regarding the impacts of these regulations on manufacturing.

13.3.2.1 Flammable-Vapor Ignition Prevention

The U.S. Consumer Product Safety Commission considered initiating a rulemaking requiring gas-fired residential water heater designs to prevent the ignition of flammable vapors but instead chose, in late 1994, to work with water heater manufacturers to develop a voluntary performance standard. The water heater industry is working on multiple design options in response to the voluntary standard. Some water heater manufacturers are working through the Water Heater Industry Joint Research and Development Consortium and/or the Gas Research Institute, and some are working independently. Although development of a satisfactory test procedure was difficult, the American National Standards Institute (ANSI) adopted a standard test procedure in 2000. The industry is proceeding to construct test facilities, as well as flammable-vapor resistant water heaters, in anticipation of a standard test procedure.

Meanwhile, some manufacturers have produced and are field testing water heaters with vapor ignition prevention designs. Others are testing a range of design options. Manufacturers are reluctant to discuss specific designs and implementation costs in detail; a value of $20/unit provided by Water Heater Industry Joint Research and Development Consortium, has been assumed as the investment required to comply with the voluntary standard. Some lower cost designs are being considered, but industry sources indicate that more reliable and mature designs are at the upper end of the cost range, and lower cost designs are more speculative and further from being commercially ready. There is no indication that new designs for flammable-vapor ignition prevention will affect energy efficiency, but manufacturers have not yet evaluated costs of achieving the minimum energy-efficiency standard with the new flammable-vapor ignition prevention design options.

13.3.2.2 Phase-Out of HCFC-141b as a Blowing Agent for Polyurethane Foam Insulation

Most residential water heaters are insulated with polyurethane foam in the space between the tank and the jacket. The insulation is foamed in place using a blowing agent included in the mixture. The heat of reaction vaporizes the blowing agent, creating an expanding frothy mass that hardens quickly into closed-cell foam insulation. Currently, most water heater manufacturers use HCFC-141b, an ozone-depleting substance, as the blowing agent. This blowing agent will be phased out by January 1, 2003.

Initially, the appliance industry, including water heater manufacturers, had leaned toward adopting HFC-245fa, which performs similarly to HCFC-141b but at a much higher projected cost. Unfortunately, according to the water heater manufacturers interviewed, the exclusive license holder for HFC-245fa technology in the United States has not committed to building production capacity sufficient to provide economies of scale in time for HCFC-141b phase-out. However, on March 27, 2000, Honeywell announced that it is building a manufacturing facility in Geismar, Louisiana to produce HFC-245fa.[1] Honeywell has publicly stated, both to the Department as well as through press releases, that enough capacity will exist in time for the phase-out.

Due to potential problems with the future availability of HFC-245fa, several manufacturers indicated during the interviews they are expecting to use a water-based foaming agent. Process control will have to be improved to handle tighter manufacturing standards required by the new agents. The higher thermal conductivity of water-based foaming agents will necessitate thicker insulation cavities to meet even current energy-efficiency standards. Thicker cavities exacerbate foam process problems, such as shrinkage, blowouts, etc., which adds to production costs. Although thicker cavities currently cause an increase in scrap, all manufacturers expect to reduce scrap levels as they learn to better control the process but do not expect to return to present levels after the change in blowing agents.

As insulation thickness increases, fewer water heaters can be fitted on the assembly line, stored in a warehouse, or shipped by truck. According to one manufacturer, for every row in a truck that is eliminated by oversized water heaters, shipping costs increase by about 25%. The trailers in which water heaters are transported are usually limited to 120" in height, which further limits water heater heights. Unless a manufacturer can ship a mixture of water heaters to the same location, additional costs will be incurred. In the worst case, increasing the sizes of water heaters will result in loss of space equal to an entire layer in shipping containers, and shipping costs will increase 50%.

Several manufacturers and industry stakeholders worry new water heaters will become so large that replacements of older, smaller units will be difficult. The most common concern is that water heaters will no longer fit through common doorways. Many water heaters are installed in tight locations, such as attics, crawl spaces, manufactured housing, etc. Several manufacturers have responded to these market demands by designing "zero-clearance" water heaters, which do not require any clearances to adjacent surfaces. Zero-clearance water heaters would need to be redesigned to satisfy the replacement market.

13.3.2.3 Evaluation of Impacts

The GRIM cash flow analysis was used to capture the financial impacts of the anti-flammability design requirement and the elimination of the HCFC-141b blowing agent. The basic assumptions and industry-supplied values for the cumulative burden are the same as those used in Chapter 8 for flammable vapors and conversion to HFC-245fa foam insulation. Design changes to meet the new regulations are expected to change:

- cost of sales per unit
- profitability as a fraction of revenue (to the extent that the cost changes are not passed through directly to customers), and
- conversion capital expenditures that might be required to modify production and test facilities.

The financial impacts associated with selection of a new blowing agent to replace HCFC-141b are uncertain. The same variables as above are affected but in different ways. That is, the use of a "drop-in" organic blowing agent would increase the cost of materials whereas the use of water could keep blowing agent costs low but result in increased costs for the use of more insulation materials

to match the insulating properties of today's foam. Flammable-vapor ignition-resistant designs and foaming agent changeovers will require changes in standard assets because:

- The adoption of the most likely flammable-vapor ignition-resistant designs will necessitate a complete redesign of the lower part of gas units. The tools and some equipment used previously to make lower parts will become obsolete.
- Most water heaters will require thicker cavities because of the foaming agent conversion. Thicker cavities in turn necessitate larger stamping dies for the outer jackets of water heaters. Although it may be possible to reuse some stamping dies, some tooling acquisitions will be required. Thicker cavities will also require some equipment investment to handle longer spud weldments.

13.3.3 Industry Cash Flow Analysis

The economic impact of proposed standards on manufacturers is determined by estimating the cash flows associated with meeting the standards and calculating a value for those cash flows. Information provided by the manufacturers and the GRIM spreadsheet were used to evaluate cash flow impacts of regulations. The GRIM spreadsheet calculates the change in net present value (NPV) of the manufacturer(s) resulting from the imposition of a regulation. NPV is defined, for the purposes of this analysis, as the present value of future cash flows for the manufacturer(s) in question. GRIM is a standard annual cash flow analysis that uses price and shipment information as an input, builds on manufacturing cost information, and accepts a set of regulatory conditions as changes in costs, associated margins, and investments. The model calculates actual cash flows by year and then determines the present value of these cash flows, for three regulatory scenarios:

1. No additional government regulations, i.e., status quo. This case provides a current industry value for a benchmark (*Base Case*).

2. Only energy-efficiency regulations (*Standard Case*).

3. All government regulations (i.e., flammable-vapor design requirements, HCFC foaming agent phase-out, and energy-efficiency standards) (*Cumulative Case*).

The ability of manufacturers to recover the investments required for each of these cases was examined under three business scenarios:

1. The average price needed for all water heaters sold to maintain the industry's current value, essentially recovering 100% of investments (*Business Scenario 1*).

2. The average price needed for all water heaters sold to recover variable costs and markup only (loss of fixed cost investment). (0% recovery) (*Business Scenario 2*).

3. The average price based on the water heater manufacturer's expected price and operating performance, from comments received during the interview process, essentially leading to recovery of 75% of investments (*Business Scenario 3*).

Some important inputs to cash flow estimates and NPV are industry shipments, manufacturer costs, capital investments, and the financial operations of the industry.

13.3.3.1 Manufacturing Costs

In order to calculate water heater unit prices and, conversely, industry revenue, incremental manufacturing costs attributable to efficiency improvements are required. In addition, the cash flow model's accuracy is contingent on the detail supplied for the manufacturing costs.

Manufacturing cost estimates are broken down into variable and fixed costs. Detailed description of the development of the variable costs is included in Chapter 8.

13.3.3.2 Capital Investments/Product Conversion

This analysis considers both capital investments and product conversion expense as fixed costs. Capital investment involves tooling and investment costs associated with evolving a water heater product line to meet the production of higher efficiency water heaters. Product conversion investment includes the research and development and marketing of higher efficiency water heaters. Capital and product conversion costs are shown below in Table 13.4. These costs are assumed for the entire water heater industry.

Table 13.4 Capital and Product Conversion Costs for Water Heaters

Trial Standard Level	Capital Conversion ($ million)	Product Conversion ($ million)
non-energy-efficiency regulations only	104.61	11.62
1	16.80	16.16
2	34.20	25.55
3	33.59	25.55
4	182.14	46.41

Some manufacturers have minimal debt and operate profitably by focusing on commercial or niche products. Other manufacturers are highly leveraged or are facing steep declines in demand because of competition. Thus, access to capital in the industry is uneven and could cause some manufacturers to go out of business if large expenditures are required to meet new efficiency standards or other regulations.

13.3.3.3 Financial Inputs

GRIM input is financial information by firm, which can indicate the extent to which individual firms may be adversely impacted by new standards. A financial profile for each firm is developed from information contained in balance sheets and income statements. This information includes:

- Tax rate (%): Used to calculate the taxes on profit before tax.
- Interest rate (%): Used as the discount rate for calculating the present value of future cash flows.
- Working capital as a percentage of sales (%): Used to calculate the change in working capital resulting from increased revenues.
- Selling, General & Administration (SG&A) ($): Includes all non-factory costs. It is computed by adding research and development (R&D), Product Conversion, and SG&A.
- R&D as a percentage of revenues (%): Used to compute R&D costs.
- Depreciation as a percentage of revenues (%): Non-cash cost used as a part of the cash-flow calculation.
- Variable overhead as a percentage of total overhead (%): Helps to separate the fixed and the variable parts of the overhead costs.

Table 13.5 illustrates a representative financial structure used for cash-flow analysis of the water heater industry. This information was based on data provided by manufacturers during February and March 1999 interviews. The original "generic" financial inputs, along with their sources, are provided in Appendix H-2, *GRIM Operating Principles*.

Table 13.5 Financial Inputs for GRIM

Financial Input	Value (%)
Tax Rate	38.00
Discount Rate for NPV	7.88
Working Capital	15.65
Standard SG&A	9.00
Research and Development	1.00
Ordinary Depreciation	3.10
Ordinary Capital Expenditures	4.50

13.3.3.4 Shipments

The shipment scenarios used in GRIM were developed in the shipment spreadsheet (see Chapter 11).

13.3.3.5 Cash Flow Impacts

Business Scenarios 1 and 2 provide a boundary to examine the financial impact of standards on water heater manufacturers. Business Scenario 1 assumes the manufacturers are able to recover all of their investments, for both standards and other regulations. This serves as a best case scenario. Business Scenario 2 is a worst case, assuming the manufacturers will not be able to recover any of their investments. Business Scenario 3 represents the expected impact based on manufacturers' comments during the interview process, and is the most likely outcome considering the current competitive landscape for residential water heaters. When Business Scenario 3 is compared to Base Case cash flow, the impact on manufacturers becomes apparent.

Manufacturer Prices and Investments. For Business Scenario 1, the impact on manufacturer price was examined with the industry maintaining its current value. For this case, an average markup is determined and applied to the various fuel options to obtain a cash flow that results in the same industry value as current business operations would be expected to produce. This assumes the water heater industry is allowed to operate under current market conditions. These results are shown in Table 13.6. Because the level of investments do not change under the different Business Scenarios, they are not shown in this table (or the corresponding ones for Business Scenarios 2 and 3).

Table 13.6 Business Scenario 1: Manufacturer Prices and Investments

Trial Standard Level	Industry NPV ($ million)	Net Change	Manufacturer Price ($/water heater)			
			Electric	Gas*	Oil	Average
Regulatory Case: Cumulative						
Base Case	325		149	163	170	156
1	325	0%	159	215	175	190
2	325	0%	176	227	175	204
3	325	0%	184	214	174	201
4	325	0%	214	373	265	292
Regulatory Case: Standards						
Base Case	325		149	163	170	156
1	325	0%	156	190	171	175
2	325	0%	173	202	171	189
3	325	0%	181	190	170	186
4	325	0%	211	347	260	278

* Includes both natural gas and LPG.

Figure 13.5 shows the relationship between the average manufacturer price and the level of investment for Business Scenario 1. It shows the average increase in manufacturer price required to support the level of investment needed to meet each trial standard level.

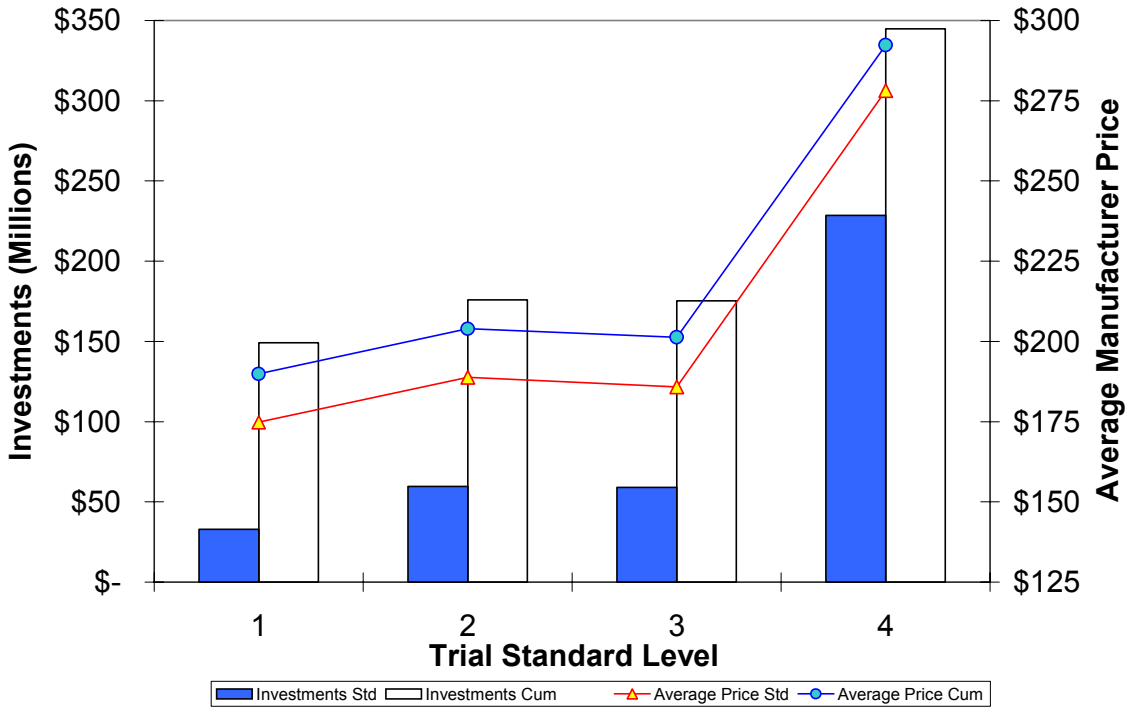


Figure 13.5 Business Scenario 1: Manufacturer Prices and Investments

Next, we analyze the impact on water heater manufacturers under Business Scenario 2, assuming they are unable to recover their investments. This can be characterized as a worse case, since it is expected the manufacturers will be able to recover some fixed costs. As Table B.7 shows, the value of the industry drops by 46% for just Trial Standard Level 1, primarily because manufacturers are assumed not to be able to recover the costs associated with new blowing agents and flammable-vapor design, since energy-efficiency standards account for a 10% reduction in industry value. For Business Scenario 2, the difference between the impacts of standards vs. the cumulative impact shows the large potential impacts that flammable-vapor ignition prevention and HCFC phase-out would have on the industry.

Table 13.7 Business Scenario 2: Manufacturer Prices and Investments

Trial Standard Level	Industry NPV ($ million)	Net Change	Manufacturer Price ($/water heater)			
			Electric	Gas	Oil	Average
Regulatory Case: Cumulative						
Base Case	325		149	163	170	156
1	176	- 46%	158	211	175	187
2	149	- 54%	174	223	175	200
3	150	- 54%	182	211	174	198
4	(20)	- 106%	211	363	261	286
Regulatory Case: Standards						
Base Case	325		149	163	170	156
1	292	- 10%	156	189	171	174
2	266	- 18%	172	201	171	188
3	266	- 18%	180	189	170	185
4	97	- 70%	209	341	257	274

Figure 13.6 shows the relationship between the average manufacturer price and the level of investment for Business Scenario 2. These results depict what could be expected in a worst-case scenario, i.e., loss of fixed cost investments. Therefore, manufacturer price is based on the markup that results in this loss.

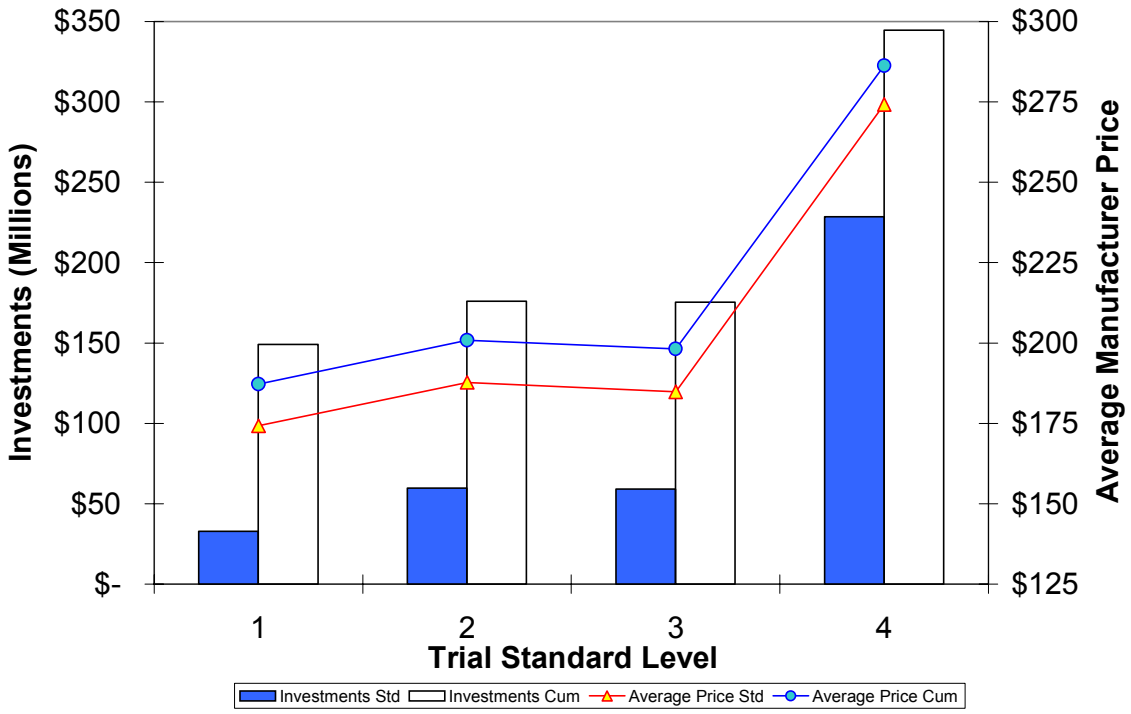


Figure 13.6 Business Scenario 2: Manufacturer Prices and Investments

During interviews, manufacturers commented on what fixed costs they expected to be able to recover under each proposed standard. Some manufacturers felt they would be able to mark up all incremental costs associated with a standard while others felt they would not be able to fully recover investments because of market pricing pressures. Based on these comments, the analysis for Business Scenario 3 is based on recovery of 75% of investments. It includes the increased costs associated with the new regulations. The results for Business Scenario 3 are shown in Table 13.8 and Figure 13.7.

Table 13.8 Business Scenario 3: Manufacturer Prices and Investments

Trial Standard Level	Industry NPV ($ million)	Net Change	Manufacturer Price ($/water heater)			
			Electric	Gas	Oil	Average
Regulatory Case: Cumulative						
Base Case	325		149	163	170	156
1	288	- 12%	159	214	175	189
2	281	- 14%	175	226	175	203
3	281	- 14%	184	213	174	200
4	239	- 27%	213	370	264	290
Regulatory Case: Standards						
Base Case	322		149	163	170	156
1	317	- 3%	156	190	171	175
2	310	- 5%	172	202	171	189
3	310	- 5%	181	190	170	186
4	268	- 18%	210	345	259	277

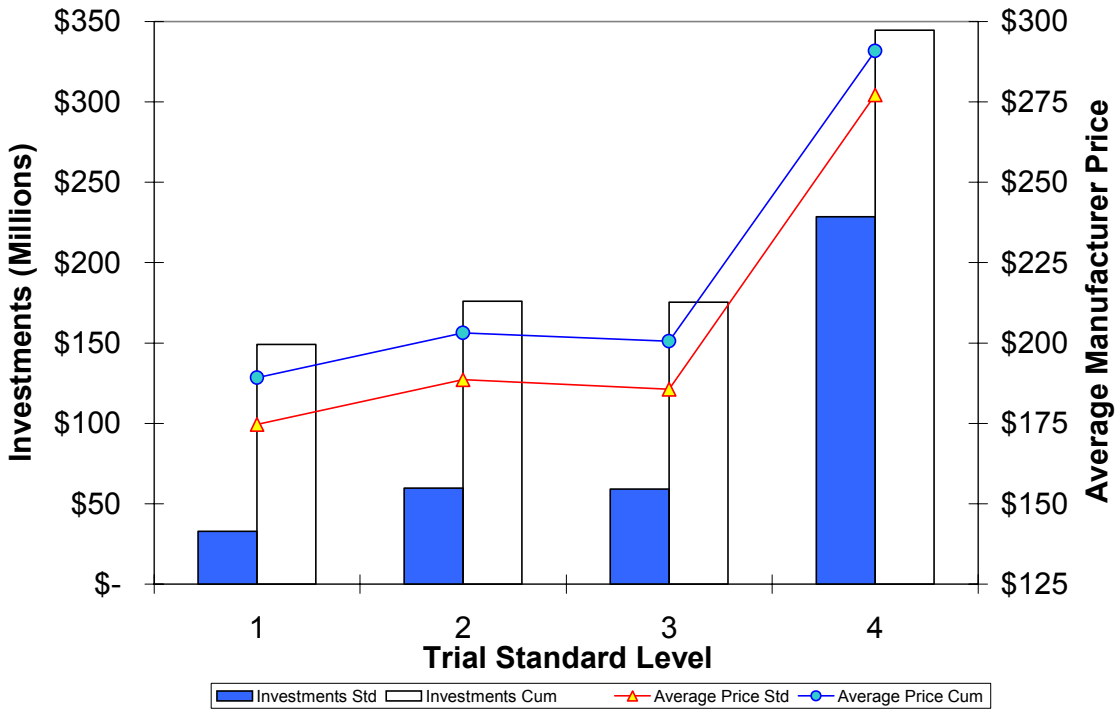


Figure 13.7 Business Scenario 3: Manufacturer Prices and Investments

Business Scenario 3 represents the most likely impact on manufacturers. Flammable-vapor ignition prevention and new blowing agent investments have a greater financial impact than energy-efficient investments needed to meet Trial Standard Level 1, 2, or 3. The combined costs of Trial Standard Levels 1, 2, or 3, flammable-vapor ignition prevention, and new blowing agents are significant and could reduce industry value by 11 to 14%.

Short-term Cash Flows. The GRIM spreadsheet calculates cash flows year by year and so can be used to assess short-term impacts. Short-term cash-flow impacts can help quantify the effect of a standard on capital investments and costs in years preceding the standard and can therefore provide valuable insights into the industry's ability to meet the standard. Short-term negative cash flows can have negative business consequences. Because of reductions in internal cash flows, manufacturers may find it necessary to increase borrowing, thereby adding to financial leverage. Diminished free cash flow may also make it difficult to meet obligations to current and new debt holders and/or to shareholders.

Short-term impacts are quantified by summarizing the cash-flow impacts on manufacturers in the few years proceeding and following a Standard. Tables 13.9, 13.10, and 13.11 show the short-term cash flows for each Business Scenario.

Table 13.9 Business Scenario 1: Short Term Cash Flows ($ million)

Trial Standard Level	2000	2001	2002	2003	2004	2005
Regulatory Case: Cumulative						
1	21	-9	-28	-68	-39	39
2	21	-15	-36	-77	-49	43
3	21	-15	-35	-77	-44	43
4	21	-55	-92	-141	-173	63
Regulatory Case: Standards						
1	21	19	12	-23	-14	30
2	21	13	4	-33	-33	33
3	21	13	4	-33	-29	33
4	21	-27	-53	-97	-159	54

Table 13.10 Business Scenario 2: Short Term Cash Flows ($ million)

Trial Standard Level	2000	2001	2002	2003	2004	2005
Regulatory Case: Cumulative						
1	21	-9	-28	-68	-40	24
2	21	-15	-35	-77	-62	24
3	21	-15	-35	-77	-58	24
4	21	-55	-92	-142	-198	27
Regulatory Case: Standards						
1	21	19	12	-23	-16	26
2	21	13	4	-33	-38	27
3	21	13	4	-32	-33	27
4	21	-27	-53	-97	-176	29

Table 13.11 Business Scenario 3: Short Term Cash Flows ($ million)

Trial Standard Level	2000	2001	2002	2003	2004	2005
Regulatory Case: Cumulative						
1	21	-9	-28	-68	-32	35
2	21	-15	-36	-77	-52	38
3	21	-15	-35	-77	-48	38
4	21	-55	-92	-142	-180	54
Regulatory Case: Standards						
1	21	19	12	-23	-14	29
2	21	13	4	-33	-35	31
3	21	13	4	-33	-30	31
4	21	-27	-53	-97	-164	47

The results from Table 13.11 are plotted in Figures 13.8 and 13.9 (Business Scenario 3, the most likely outcome).

When cumulative effects are taken into account, the manufacturers may be negatively affected in the short term, regardless of the standard. This could lead to one of three outcomes:

1. Manufacturers may lose in those years as shown in the above charts.
2. Manufacturers, in the short term, may try to raise costs to dealers/distributors. This could lead to increased costs to consumers. However, over the long term, because of the competitive nature of the water heater industry, prices may decline to levels similar to those presented in Business Scenario 3.
3. Manufacturers could raise the cost to dealers/distributors for current products to offset the negative cash flows in the years preceding the Standard. This could increase the cost to dealers/distributors of current baseline water heater by as much as 12% (the amount of revenue needed to offset the greatest potential loss for Trial Standard Level 4, in the year previous to the Standard taking effect), which could be passed on to consumers.

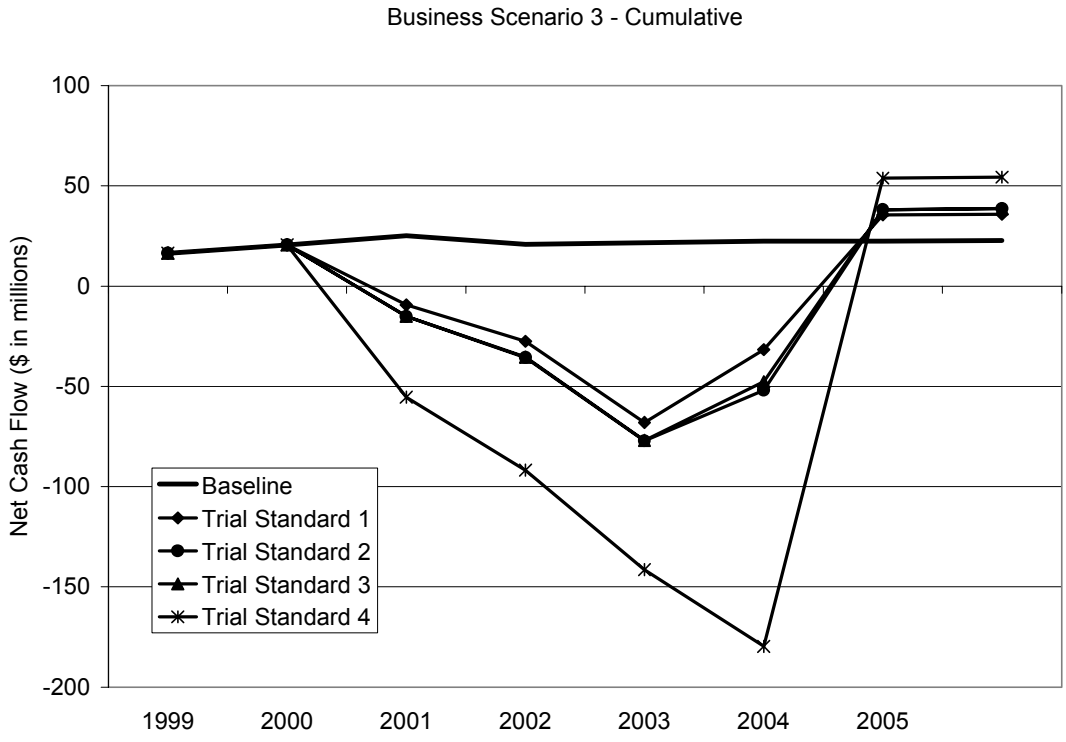


Figure 13.8 Short-Term Cash Flows for Business Scenario 3 Cumulative

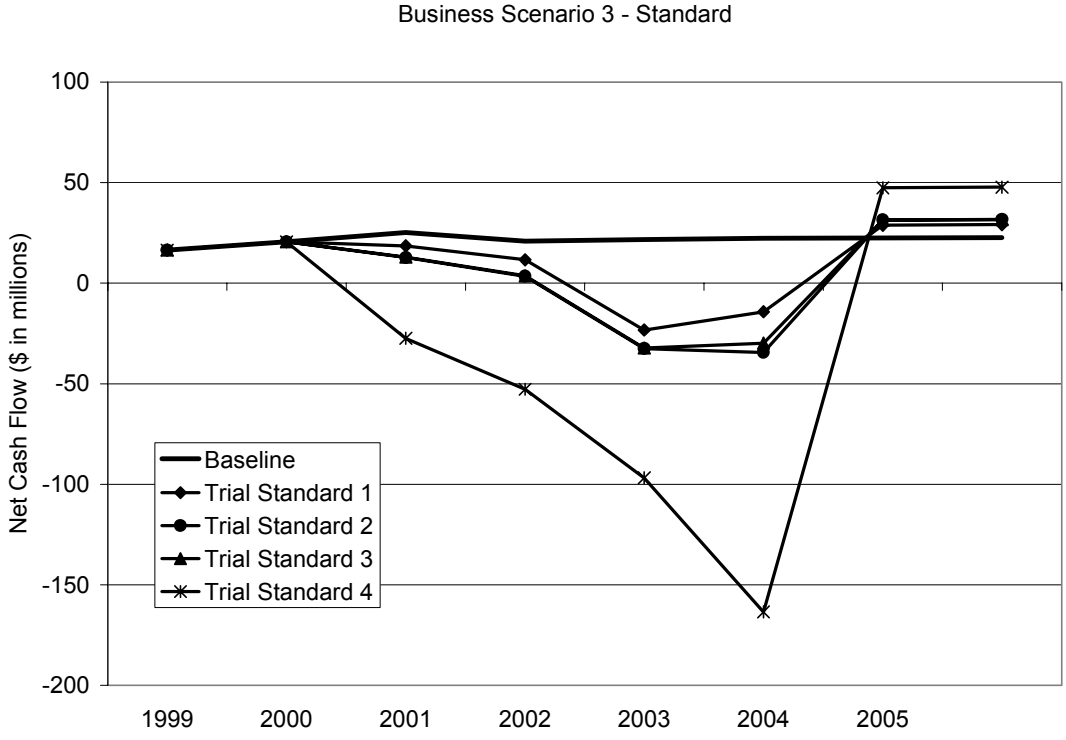


Figure 13.9 Short-Term Cash Flows for Business Scenario 3 Standard

13.3.4 Plant Closures, Loss of Capital Assets, and Impacts on Manufacturing Capacity

One of the potential outcomes of new standards could be the forced retirement of existing manufacturing assets, including tooling and investment. The *Manufacturer Interview Guide* used questions to identify impacts on manufacturing capacity and were developed to understand the impact of a Standard on:

- U.S. and North American manufacturing capacity
- Capacity utilization and plant location decisions in the U.S. and North America both with and without standards
- The ability of manufacturers to upgrade or remodel existing facilities to accommodate a new product mix
- The nature and value of stranded assets, if any.

In general, manufacturers expect to be able to meet future demand with little impact on manufacturing capacity unless Trial Standard Level 4, which requires side arm gas-fired water heaters and plastic tank electric units, is mandated. Currently, the U.S. industry has far more manufacturing capacity than the domestic market can absorb. Manufacturers estimated the industry is operating from 60 to 80% of total capacity. Table 13.12 summarizes the impacts on capacity of the four trial standard levels.

Table 13.12 Impacts on Capacity

Trial Standard Level	Impacts on Capacity
1	No expected major impact on capacity. Increased cavity sizes will initially increase scrap rates from foaming errors.
2	No expected major impact on capacity beyond the issues discussed for Trial Standard Level 1.
3	No expected major impact on capacity beyond the issues discussed for Trial Standard Level 1.
4	Plastic tank electric units require a manufacturing process that makes current electric water heater manufacturing lines obsolete. The required capital investments to convert existing or build new facilities would potentially cause some manufacturers to cease production of electric water heaters. Additionally, side arm gas water heaters would require large investments and reduce manufacturing capacity. Manufacturers expressed concern that foreign competitors who already mass produce such water heaters would gain access to the U.S. market and displace domestic producers. Side arm water heaters are no longer manufactured in the U.S. because of low demand.

Because of the phase-out of HCFC-141b insulation blowing agent and the need for flammable-vapor ignition-resistant designs, nearly every product line will likely have to be redesigned, recertified, and launched for sale in the U.S. regardless of what energy-efficiency standard is chosen. One manufacturer claimed it would take two years to retool, which leaves a year to finalize designs before the new standard goes into effect. Several manufacturers indicated a preference to retool for new foaming agents, proposed energy-efficiency standards, and flammable-vapor resistant designs at the same time, to limit costs and avoid redundant efforts.

13.3.5 Employment Impacts Assessment

To assess employment impacts resulting from standards, the *Manufacturers Interview Guide* explored current trends in production employment and solicited manufacturer views on employment changes that would result from new energy-efficiency standards. The employment impacts section of the interview guide was used to understand:

- Current employment levels associated with manufacturing at each production facility
- Expected future employment levels both with and without a standard
- Differences in workforce skill and issues related to retraining of employees.

The employment effects of HCFC-141b foaming agent phase-out and incorporating flammable-vapor ignition-resistant gas water heaters were considered minimal by all manufacturers interviewed. However, all interviewed manufacturers indicated that a transition to plastic tanks for

electric water heaters would result in domestic job losses. A transition to side arm water heaters could also result in domestic job losses.

Without standards, total employment in the industry will be a function of labor productivity and market growth. No revolutionary technologies have recently emerged to challenge current manufacturing processes and related employment levels. Foreign competition is not expected to be a threat to commodity water heater manufacturing operations. Manufacturers expect a transition to alternative foaming agents will not result in employment losses. Industry-wide voluntary adoption of flammable-vapor resistant gas water heaters is not expected to change employment levels.

Because the manufacturing processes for gas and electric storage water heaters are generally the same and these two fuels dominate the market, three factors are likely to influence overall water heater market employment in the U.S.:

1) Switching to other water-heating technologies. Unless the cost of switching to alternative water-heating technologies becomes attractive, consumers are expected to replace their water heaters with like models.
2) Competition from abroad; high shipping and low overall labor costs for water heaters mean there is little incentive to compete from abroad. Higher efficiency standards will further increase cavity sizes and thus shipping costs. Any large increases in labor costs would prompt at least one manufacturer to shift more production abroad, however.
3) Productivity and market growth: The vast majority of new homes are expected to use low-cost storage water heaters. Overall market growth of 2.5% per year and modest productivity gains ensure current employment levels for the foreseeable future. A steady and predictable replacement market ensures future demand.

The impacts on employment of the four trial standards levels are summarized in Table 13.13.

Table 13.13 Impacts on Employment Levels

Trial Standard Level	Impacts on Employment Levels
1	No expected major impact on employment levels
2	No expected major impact on employment levels
3	No expected major impact on employment levels
4	Plastic tank electric units require a manufacturing process that make current electric water heater manufacturing lines obsolete. This could lead to some manufacturers abandoning the electric water heater market. Although some of the employment would shift to manufacture gas-fired water heaters, employment levels would be substantially reduced. Side arm gas water heaters would require large investments and reduce manufacturing capacity. This reduction in capacity would be accompanied by a reduction in employment levels.

13.3.6 Impact on Small Manufacturers

Small manufacturers of water heaters in the U.S. concentrate on niche products such as electric only, solar, oil-fired, indirect, or marine systems, etc. The effects of standards depend on each company's product line.

Small manufacturers use a variety of insulating and lining materials, which include stone, fiberglass, and a variety of foams. At least one domestic producer already uses water-blown foam in its water heaters. Because efficiency is already a strong selling point for these manufacturers, investments will be required if manufacturers decide to significantly surpass new standards. Retooling would be amortized across a much smaller volume than that of a larger competitor, so it would have a larger impact than on a large manufacturer.

Low volumes in niche markets necessitate somewhat different manufacturing processes than the ones used by large commodity producers. Consequently, small manufacturer's material and labor costs will increase more compared to their larger competitors because of supplier discounts and production efficiencies. Flammable-vapor resistant technology is a good example of this trend. Table 13.14 describes the expected impact on small manufacturers for the trial standards levels.

Table 13.14 Impact on Small Manufacturers

Trial Standard Level	Impact on Small Manufacturers
1	No expected major impact beyond what will be seen by the rest of the industry
2	Because many small manufacturers use increased efficiency as a selling point, standards two and three could impact the market differentiation on which small niche manufacturers rely. These same manufacturers offer additional product attributes that should help protect their markets..
3	Same as Trial Standard Level 2
4	Plastic tank electric water heaters are probably impossible for small competitors to manufacture unless licensing fees and market conditions are very favorable. Thus, any standard requiring plastic tanks will most likely cause small manufacturers to abandon the electric market affected by the rulemaking. Side arm gas water heaters would require large investments and may also prompt small manufacturers to leave that segment of the residential market.

13.3.7 Competitive Impacts Assessment

Changes in industry concentration—distribution of market share among manufacturers—can signal potential reductions in competition. With reduced competition, firms can more easily use market power to increase profits. Firms may exert market power by raising prices or reducing quality, service, and other characteristics that consumers value. The water heater industry is a fiercely competitive market. Several manufacturers indicated the fierce competition and the array of regulations facing water heater manufacturers could speed up the exit of any manufacturer already vulnerable or considering leaving the market.

13.3.8 Global Competition

Global competition currently has little impact on the U.S. water heater industry. One multinational manufacturer stated that large increases in labor costs would prompt it to shift more production abroad. The long-term trend to manufacture labor-intensive components in low-labor-cost areas is independent of any energy-efficiency standard. Some purchased parts used in water heaters, such as gas controls, are already manufactured outside the U.S. However, the majority of parts in water heaters are still purchased domestically. Table 13.15 discusses the effect the trial standard levels may have on global competition.

Table 13.15 Effect on Global Competition

Trial Standard Level	Effect on Global Competition
1	No additional expected major impact
2	No additional expected major impact
3	No additional expected major impact
4	Side arm gas water heaters are no longer manufactured in the U.S. Any energy-efficiency standard requiring side arm water heaters could result in market entry of foreign manufacturers who already mass produce such heaters.

Several manufacturers have made international investments or acquisitions in the water heater industry. This trend is also assumed to be independent of proposed standards.

13.3.9 Other Comments

13.3.9.1 Manufacturers' Comments on Consumer Utility

All interviewed manufacturers expressed possible concern about the loss of utility to consumers who have water heaters located in small spaces. Many residential water heaters are certified for zero-clearance and are installed that way, especially in mobile homes, crawl spaces, attics, and manufactured housing.

If a water heater is installed in a small space, any added insulation might prevent simple replacement. Instead, a consumer may be forced to accept a unit with a smaller storage tank, remove a door or alter the water heater space, or buy and install multiple water heaters. All of the trial standard levels (except for oil Trial Standard Level 3), coupled with the use of new blowing agents, will increase the size of water heaters. According to one manufacturer, half of all installations would be affected by a change in height or width of the water heater. Several manufacturers indicated they might discontinue models designed for small spaces when new energy-efficiency standards go into effect.

REFERENCE

1. Honeywell Inc., *Press Release: Honeywell Set To Commercialize New Non-Ozone-Depleting HFC-245fa Blowing Agent Product, Compound's Insulating And Environmental Properties Helping To Spur Increasing Customer Acceptance And Demand; Long-Term Customer Supply Contracts In Place,* March 27, 2000. Morris Township, NJ.