

**White Paper Summary of Interviews with Stationary
Fuel Cell Manufacturers**

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by the

California Stationary Fuel Cell Collaborative

Executive Summary

In the last year, the fuel cell industry has continued to develop and to crystallize its plans for the future. Procurements and incentives that could have driven significant purchases of fuel cells, technical advances and breakthroughs, and cost reductions through economies of scale and reductions in component pricing did not materialize as anticipated in 2001 and 2002. While these challenges kept the industry from meeting some of the sales and production goals, they also allowed the industry to reassess the market and to develop plans that take advantage of the current economic outlook and energy needs for the nation.

As in previous years, this year's survey reports the result of interviews with key personnel from several manufacturers of phosphoric acid, molten carbonate, proton exchange membrane, and solid oxide fuel cell systems. To retain the confidentiality of the interviewees and the manufacturers, data is aggregated and specific references to companies or products are removed.

Overview

Process

Major manufacturers of phosphoric acid, molten carbonate, proton exchange membrane, and solid oxide stationary fuel cells were interviewed in August, 2003. The purpose of the interview was to determine the current and projected manufacturing capabilities, sales volumes, and installation costs of stationary fuel cell power plants in the state of California over the past year and to project these data over the next three years.

The purpose of the interviews was to compile information relative to the commercial availability of fuel cells for power generation over the next few years and to identify the actions that the State could take in order to create a more receptive environment for their installation.

Summary of Survey

A standardized list of questions (see Attachment 1) was sent to each of the companies prior to the interviews. Interviews were conducted between key personnel from the manufacturer and a representative each from the California Air Resources Board (ARB) and the National Fuel Cell Research Center (NFCRC).

Manufacturers were asked to present their expectation of:

- Sales for the year ending June, 2003
- Their manufacturing capability and sales projections for the next three years
- Their projected product portfolio, price expectations and warranty/service contract offering; and
- The applications targeted for their products based on their business plans

The information compiled and presented herein reflects a range of fuel cell product sizes, fuel cell product types, expected efficiencies, expected life of the fuel cell stack and associated equipment, manufacturing strategies and cost expectations.

The manufactures also identified barriers to market entry and market facilitation, incentive strategies, as well as opinions on the performance of the California Stationary Fuel Cell Collaborative (CaSFCC) over the past year and suggestions for the role of the Collaborative in the coming year. These results are summarized in this document.

Results

Industry Products

In 2001, the stationary fuel cell community was generally understood to have a single commercial product (a 200kW PAFC unit) manufactured by UTC Fuel Cells. In last year's survey, several companies offered a broader array of products with different system technologies (i.e., PEMs, SOFCs, PAFCs, MCFCs). This year's survey reveals consolidation or anticipated consolidation of product lines to better match technological advances and projected consumer needs.

Production Capabilities and Sales Potential of the Stationary Fuel Cell Industry

This year's survey of projected manufacturing capacity and sales (Figure 1) emphasizes the industry's sober assessment of the future. Current production capacity begins at a little over 100 MW and rises until 2005 or 2006 when new production facilities will come on line doubling manufacturing capacity.

While the rise in MW sales (Figure 1) may seem gradual, the actual growth is quite substantial. The starting point in 2003 is 9 MW. This increases to over 60 MW in 2006—an almost doubling of MW sales each year for the next three years.

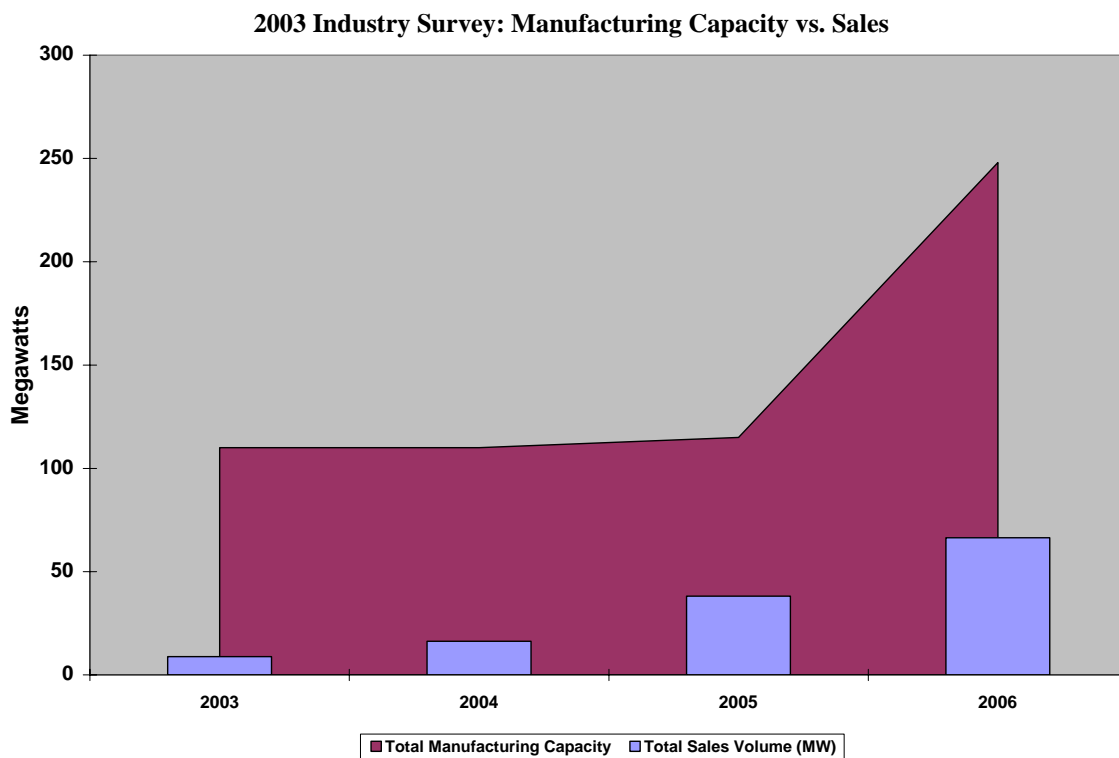


Figure 1

While this increase in capacity and projected sales is ambitious, it also reflects a more conservative assessment of the market than in previous surveys. For example, the projected MW capacity for 2006 is less than half of the projected MW capacity given by manufacturers in last year's survey for 2005 (Figure 2). Thus manufacturers expect to need less production capacity and believe that the ramp-up in production will occur later than previously thought. Similarly, the total sales volume is a full order of magnitude lower in 2006 than the industry projected in last year's survey for 2005 (Figure 2). Again, manufacturers are anticipating slower sales with steady growth in the near term.

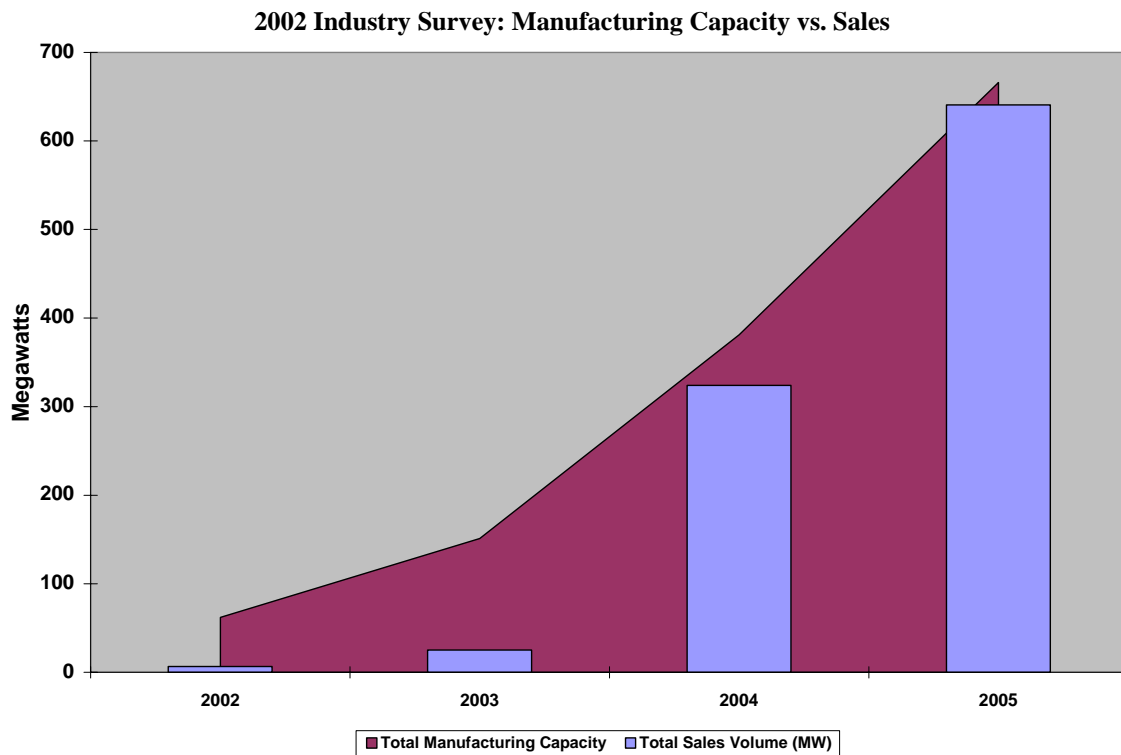


Figure 2

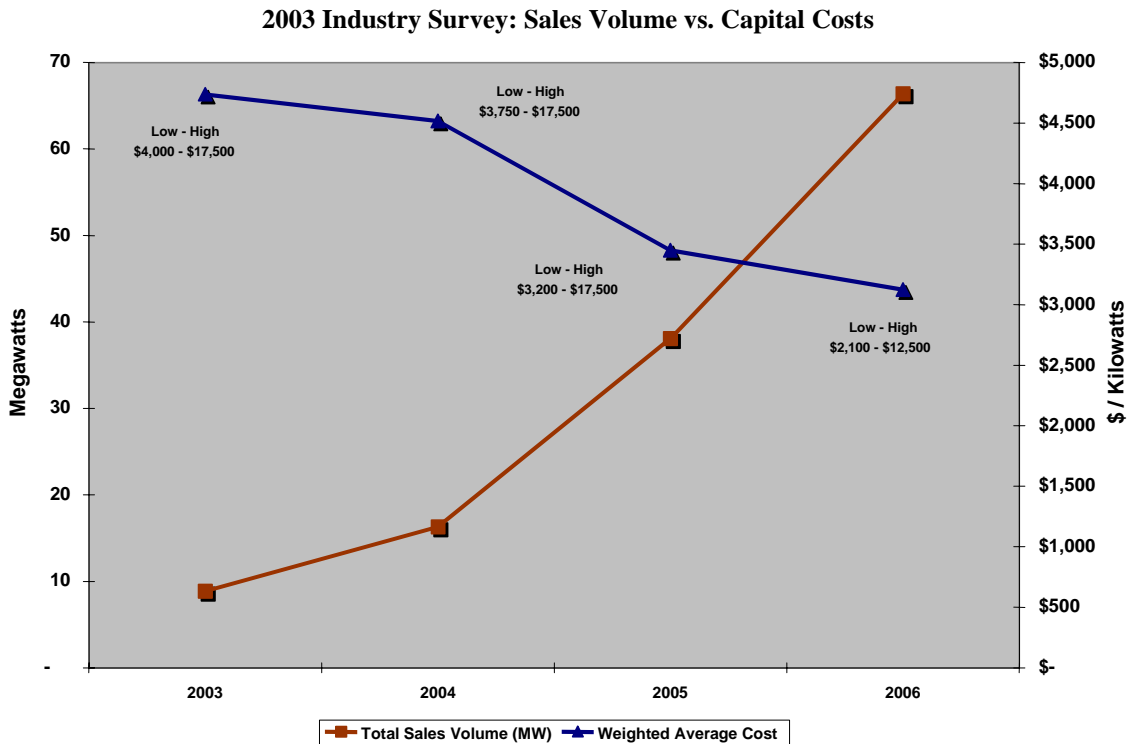
The survey participants cited several factors that have weighed in on the lowered projections. In particular, a shift in the economics of electricity versus gas has favored the purchase of electricity from the grid over the on-site production of electricity using natural gas. While the CPUC incentives administered were projected to end in 2004, the program was extended in its present form through the end of 2007. The termination of those incentives will reduce the attractiveness for on-site power generation in many cases. Although these projections are not as exuberant as in previous years, the projections still show strong growth in the industry.

Capital Costs

This year's survey affirms the general trends depicted in last year's survey: total sales volumes are increasing and the weighted average costs are decreasing. While fuel cell manufacturers are making progress on both fronts, the numbers are muted in comparison to last year's projections.

As discussed, the sales volume in MW is expected to rise from 9 MW to over 60 MW by 2006 (Figure 3). The steady projected increase reflects the growing interest and market introduction of fuel cells while recognizing the logistical, technological and economic barriers that have a dampening or delaying effect on sales.

The 2003 survey indicates weighted average cost starting at over \$4,700/kW and decreasing slightly to just over \$3,100/kW (Figure 3) by 2006. The range started at \$4,000/kW up to \$17,500/kW in the current year and decreases to \$2,100/kW to \$12,500/kW in 2006.

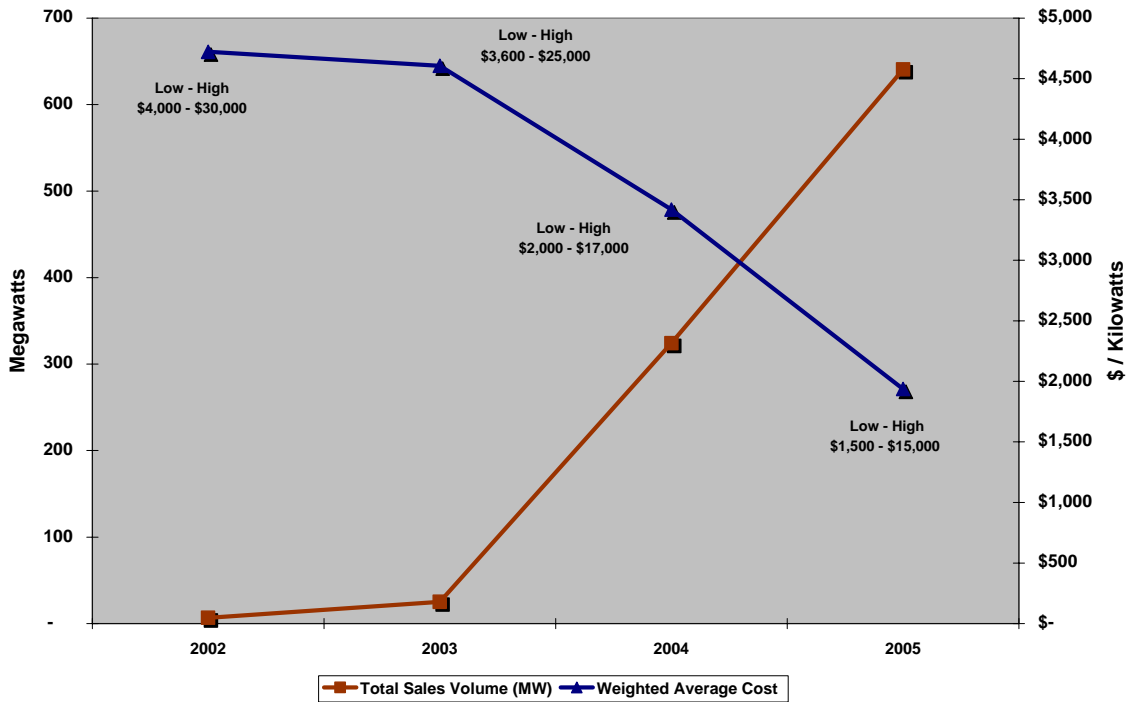


Note: Weighted average cost = $\frac{\text{Sum (Individual Company's MW sales volumes} \times \text{Individual Company's Projected Capital Cost)}}{\text{Total Sales MW Volume}}$

Figure 3

The general trends of the 2003 survey (Figure 3) are the same as the 2002 survey (Figure 4) although the data points have changed. The key change is in the total sales volume. As depicted in Figure 1 and 3, total sales volume is projected to peak at 60 MW by 2004. As mentioned previously, in last year's survey, the peak was an order of magnitude higher—over 600 MW projected by 2005 (Figures 2 and 4).

2002 Industry Survey: Sales Volume vs. Capital Costs



Note: Weighted average cost = $\frac{\text{Sum (Individual Company's MW sales volumes} \times \text{Individual Company's Projected Capital Cost)}}{\text{Total Sales MW Volume}}$

Figure 4

Interestingly, the weighted average cost line remains very close the last year's projections. While the general trend of the weighted average cost line is the same, two aspects have changed from previous years: the slope of the line is flatter and the range (low and high) of the underlying data has changed. In last year's survey, the weighted average started at \$4,722/kW and dropped to \$1,938/kW. This year's survey starts higher—at \$4,737/kW but only drops to \$3,125/kW. The flattening of the slope reflects the lower projected sales volumes that negatively impact the possibility of capitalizing on economies of scale. The flattened line also reflects the technological constraints that keep costs higher than originally projected.

The high and low values of the weighted average cost line also provide insight into the market trend. While the low value decreases, it does not decrease as significantly as in last year's survey. The high value, however, starts lower than in last year's projection and continues downward ending lower in 2006 than last year's projection for 2005. This may indicate that pricing pressure on the more expensive (per kW) systems will continue to drive the price down to compete with systems that are less expensive on a per kW basis. The reduction may also indicate projected technological advances or improved production efficiencies for these systems.

Warranties and Service Contracts

As expected, fuel cell manufacturers are providing warranties and service contracts for their products. While the pricing varies widely, the effort to provide warranties implies 1) a confidence of the fuel cell manufacturers in their products and 2) a strategy to transmit that confidence to fuel cell customers. The service contracts also help give purchasers confidence in the longer-term reliability of the product while spreading the cost of repairs for the units that do not perform up to expectations over a larger base—a sort of “insurance” for the manufacturers.

Key Customers

The key customers have not changed since the 2002 survey. Early adopters include federal, state, and local governments and agencies followed by energy service companies (ESCOs). All are purchasing to demonstrate and understand the technology.

While the key customers have not changed significantly, the shift that began last year continues to become more pronounced in the current year. Manufacturers continue to focus on hospitals, universities, light industrial processing and other locations where customers can implement heat recovery systems. The recent decreases in cost of electricity and increases in the cost of natural gas have heightened the focus on these clients. The focus has increased because these clients are able to take advantage of heat recovery systems that make the economics of using a fuel cell most advantageous.

Manufacturers also recognize facilities that require high power reliability, uninterrupted power supply, or are located in remote areas that do not have easy access to the electrical grid as key customers. These customers include telecommunications, broadband and locations that require high energy security, as well as the more than 1 million U.S. homes that are not currently connected to the power grid.

California Customers

The surveyed companies affirmed the importance of California in their planning and sales. Companies projected California sales at anywhere from 0 – 25% of total sales with an average of 8%. This translates to over 10 MW of total sales through June of 2006.

Incentives, Demonstration Funds, and Rebates

The most significant barrier to widespread fuel cell commercialization is the high capital cost required to install a system. Companies installing fuel cell systems are faced with a complex decision. Variables include not only the reliability of the system itself, but also the capital cost of auxiliary systems, the complex incentive, rebate, and tax credit programs and, in many cases, the fundamental challenge of determining whether the future cost of electricity or natural gas will be lower.

Manufacturers cited several programs that are accessible for fuel cell system implementation. Those included the CPUC Self-Gen Program as well as the California Energy Commission's (CEC's) Emerging Renewables Program. While these programs offer basic support for the installation of systems, manufacturers cited several areas of improvement.

The CPUC program includes three levels. Each level includes different technologies (or in the third level, a split between renewable and non-renewable fuels for the technologies). For the second level, which includes fuel cells using non-renewable fuels, manufacturers recommended increasing the incentive from the current amount of \$2.50/W up to 40% of eligible cost to \$3/W and up to 50% of the eligible cost. Another option is to follow the lead of other states that recognize fuel cells running on natural gas as renewable technologies. These steps would allow fuel cells to compete with less environmentally friendly technologies such as reciprocating engines and microturbine generators.

Manufacturers also discussed the concern that level 1 could raid the funding originally set aside for level 2 (the fuel cell level) thus reducing the total funding available for the fuel cells. The projected growth for fuel cells relies, in part, on the availability of incentives to provide a spark for the market. The use of those funds by non-fuel cell projects reduces the total available funding and reduces the incentive for companies to add fuel cell systems. Since fuel cells are in the earlier stages of commercialization, the CPUC should protect those funds in anticipation of an acceleration of use over the next few years.

Other concerns included the projected ending of various incentive programs. If the programs had ended in 2004 as planned, the fuel cell market would have faced a significant barrier to widespread commercialization. However, the program was extended by the passage of AB 1685 (Leno) which provided the same provisions through the end of 2007. In the interim, there are current proceedings that would evaluate the provisions of the self-generation program, which could result in changes that would impact the manufacturers.

Exit Fees and Standby Fees

In the 2002 survey, several respondents expressed concerns about the CPUC's consideration of exit fees and standby fees. One concern was the level of the fees. High fees could stifle the market. The second concern was the mixed message the fees would project. The conflict between the CPUC's incentive programs and the implementation of exit or other fees would send conflicting signals regarding the viability of the distributed generation market and of the CPUC's support of the market.

In May 2003, the CPUC ruled in favor of exempting fuel cells under 1 MW from exit and standby fees. Unfortunately, the decision to exempt "ultra-clean" technologies also

included reciprocating engines and microturbine generators—two technologies that compete directly with several fuel cell applications.

Collaborative Report Card: 2002 – 2003

Companies affirmed the efforts of the Collaborative to bring industry together. This effort was accomplished through various meetings, working groups and cooperative efforts the Collaborative facilitated or encouraged. While bringing the companies together affirmed the pre-existing market perceptions of the individual companies, the collaboration also helped companies gain an appreciation for the bigger picture as they saw similar concerns echoed by other Collaborative participants.

This shared effort led to the second major theme of the surveys: the Collaborative's ability to unify the individual industry concerns into a single voice. California's energy market dynamics make it critical for the industry to have a unified presence and voice. This voice is critical not only to ensure the representation of the fuel cell industry, but also to ensure that other states that look to California's lead in the industry will implement strategies that promote clean technologies.

The manufacturers affirmed the need for the collaborative to continue to pursue educational and outreach efforts. In particular, the manufacturers are concerned with the general perception that fuel cells are still a future technology instead of an option for today.

Finally, one company pointed out that the Collaborative had played a critical role in helping the industry to understand itself. The publication of the aggregated results from the last survey "regrounded expectations."

Conclusions

While the expectations for the commercial fuel cell market have been tempered since last year's survey, the companies the Collaborative surveyed still expect significant growth over the next few years. The projections show the industry on a growth trend with no expectation for the growth to plateau. Recent changes in the economics of electricity generation and the incentives and regulations surrounding fuel cell distribution as well as the slower growth of the U.S. economy have made companies more cautious about implementing aggressive growth plans.