

Commercialization of fuel cells as a partial energy service (extended Abstract)

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In order to construct a vision for the year 2000 and beyond for fuel cells and Southern California Gas (SoCalGas), it is necessary to examine the past and present in a few major areas:

- fuel cell technology characteristics
- manufacturer's role
- evolving energy policies and market trends
- SoCalGas' past and present programs

SoCalGas is the largest gas company in the US, serving 15 million people through 5 million gas meters with approximately 10 000 employees. The company is involved with the production, transmission and distribution of natural gas to roughly the lower half of the State of California. The residential and commercial customers account for 44% of the gas sent out, industrial 38% and electric utilities 18%. Fuel cells being developed and commercialized today can address all of these market and customer segments. Natural gas is the clear choice for the next several decades to power fuel cells and, therefore, SoCalGas stands to play a key role in their development, commercialization and marketing programs.

SoCalGas Company's position with fuel cells can easily take two paths. First, we will provide the natural gas distribution infrastructure to electric utilities and customers who may eventually be using fuel cells as dispersed generations in larger sizes. The second path is where gas customers begin using fuel cells as on-site generators. In this case, SoCalGas may have a more direct role in developing the currently non-existent infrastructure for fuel cells.

SoCalGas Company's marketing activities are strongly directed to serving our customers and meeting their energy needs. Customer needs become the starting point for technical developments and field testing of new equipment or service. Following a successful development of fuel cell equipment, the Marketing Department working closely with manufacturers begin the commercialization process that is designed to address the original customer need. A union between the manufacturer, utility and customer is essential to bridge fuel cells from development projects to marketable products.

Fuel cells and SoCalGas Company go back 25 years with the research and field testing of first a 12.5 kW generator and then a 40 kW co-generation system. The high costs through the years have been one of the main reasons for continuing the development and scale-up work. The co-generation feature has helped to recover the maximum energy available, thereby providing additional value for the capital cost. Other fuel cell characteristics such as electrical efficiency, pre-packaging and low maintenance have also brought fuel cells to the threshold of commercialization. SoCalGas Company's reasons for pursuing fuel cells over 25 years have been verified at this point. In fact, in light of current trends, we feel more confident fuel cells will be a technology for the future.

SoCalGas Company's future with fuel cells may have started with the early field testing and demonstration programs. We identified the customer, installed the units, operated and maintained the equipment while we determined the technical and market suitability of on-site fuel cells. SoCalGas was able to gain the first hand knowledge and experience for a critical element of commercialization.

At the conclusion of the development and testing activities, we felt the technology was ready to be moved forward but the traditional marketing approach of customer ownership was not. The first fuel cell to be in a marketable position was a 200 kW phosphoric acid unit offered by International Fuel Cell Corporation's subsidiary ONSI. The specifications and operating characteristics of this unit were a good match to customer needs in California. We saw that between an on-site fuel cell's capability of meeting customer needs coupled to the changing energy policies that new energy opportunities could open up. For SoCalGas environmentally clean and efficient fuel cells with the ability to be packaged in smaller sizes have a strong market potential.

The environmental concerns present in Southern California today and emerging nationally in the next few years are likely to move toward global policies in the future. Fuel cells can have a profound impact on meeting emerging environmental policies and may actually be the least cost answer to accomplish this for a diverse set of energy requirements by customers. The use of internal combustion engines for energy generation is on the verge of extinction unless drastic emission counter measures can be developed in the next couple of years. Similar combustion equipment (i.e. turbines and boilers) are also up against a difficult emission reduction schedule by several Air Quality Management Districts.

Relevant to the future of fuel cells are the past and present barriers to acceptance that must be addressed in the commercialization, marketing and business plans. These barriers need to be addressed by the manufacturer and utility through to the customer to be successful. There will be more energy choices available to customers in the future. It will be a combination of the technology and marketing together that determine how well fuel cells meet the end-user needs. Fuel cells are more of a revolutionary change in energy generation equipment than an evolutionary change. Thus, the commercialization and marketing programs will also require a departure from the norm. Any fuel cell commercialization plan must address the following barriers:

- high initial cost of equipment
- high installation and maintenance costs
- introduction into a mature and highly competitive energy business
- timing and availability of fuel cell equipment, the changing of technically driven to market driven programs

SoCalGas Company has developed a fuel cell energy service to begin commercialization of the equipment with our customers. The energy service appears to be the best choice to overcome the existing barriers, capitalize on the fuel cell's benefits and translate them into opportunities. In the energy service SoCalGas assumes the key role by offering the equipment to customers with our ownership. SoCalGas has purchased the units from the manufacturer, we will market and site the equipment with customers, install and operate the systems throughout their expected 20 year life. This energy service parallels the role we have historically played with fuel cells and is a logical foundation to begin commercialization and build a marketing strategy from.

The following reasons figured strategically in the decision of an energy service. Like any company, SoCalGas wishes to continue to grow in profitable areas. The regulated gas distribution business has limited growth opportunities and has remained basically flat. The Fuel Cell Energy Service is a means to capture a larger share of

the energy market. An energy service complements the company's existing investment in the gas distribution business. A fuel cell energy service can be three times more profitable than gas sales alone. Even early commercialization programs can be more profitable. The energy service combats the move by customers electricity by meeting their needs. The Fuel Cell Energy Service enhances SoCalGas' image by providing a solution to environmental and energy problems.

When assessing the profitability of fuel cells and gas use by customers, we examined the residential and commercial customer class where 44% of our gas is used today. For a 200 kW fuel cell at full load, it requires 179 residential or 31 commercial customers to equal the gas used by the fuel cell. A capital dollar invested by SoCalGas to presently serve conventional use (i.e. pipeline, compressor, etc.), has a payback of approximately 16 years for residential and 9 years for commercial customers. By comparison, a 200 kW Fuel Cell Energy Service with the same dollar invested by SoCalGas is projected to start with a 12 year payback, move to a 6 year payback during the second stage of commercialization and reach a 3-4 year payback with the mature pricing of equipment.

The early stages of commercialization and pricing are viewed as necessary steps to move fuel cells into a profitable future technology that will extend well beyond the year 2000. In exchange for the costs and risks to SoCalGas Company for commercializing fuel cells, we have worked with the manufacturers and customers to develop a strategic market and business position. We continue to build on our past roles with fuel cells in areas of a marketing, installation and operating infrastructure lacking at the present time.

The initial markets and customers that we are working with today are the familiar co-generation prospects that would use conventional technology. These typical customers will use all of the electrical and thermal energy from a fuel cell on a continuous basis. The first 10 fuel cells are scheduled to be installed in the markets listed below:

- hospitals
- office
- university
- correctional institution
- integrated community development
- hotel
- electric transportation system
- food processor

As costs for fuel cell equipment and installation are reduced, the market will expand into multifamily residential and a diverse commercial/industrial energy industry. New construction offers the greatest potential to fully integrate an on-site fuel cell into the building, therefore, promising the greatest benefit to a customer or building owner. District or central heating and cooling energy service systems will become more profitable when considering a fuel cell's electric to thermal ratios. These energy service strategies come closer to meeting the customer's needs.

A Fuel Cell Energy Service not only meets customers needs but may do so at an energy savings. SoCalGas Company is offering a 5-15% reduction to customers in the fuel cell program for the electrical and thermal energy produced by the on-site units. The customer is charged for the gas used by the fuel cell, at existing co-generation rates, plus a facility fee. The facility fee is designed to cover the operation, maintenance, fuel cell cost, installation and site restoration at the end of 20 years. A customer has a 5-15% savings when the fuel cell is operating and reverts to the conventional costs when the system is down for maintenance. Typically a customer with a 15% savings

will see a \$30 000 year savings and SoCalGas will have a \$80 000 net cash flow to recover the capital investment. SoCalGas must strive to achieve a high fuel cell availability to provide a cost-effective energy service.

The conclusions we draw from our past and present fuel cell activities are:

(i) *Market potential.* The market potential for fuel cells is large to very large, depending upon the total installed cost and operating costs. On a daily basis, we are recognizing profitable diverse fuel cell applications for our customers in an energy service. Depending upon the cost and capabilities of fuel cells in the future, *all* customers are potential energy service candidates.

(ii) *Business structure.* The business structure of energy service to commercialize fuel cells continues to represent the best strategy for the fuel cell industry. A utility rate of return and payback on capital invested will support a higher equipment capital cost than private industry. At a fuel cell cost of approximately \$2000/kW the capital invested becomes more profitable than gas distribution alone.

(iii) *Market approach.* At the point of initial commercialization customers or buildings, capable of using all of a fuel cell's potential, electrical and thermal energy represent a solid fuel cell energy service application. As fuel cell costs are reduced through manufacturing, installation and operation, additional market applications for multifamily, residential and commercial office space become viable market opportunities for on-site fuel cell generation.

(iv) *Financial.* The prospects of commercialization of fuel cells must be viewed carefully as initial capital costs will be high and must give way to a profitable on-going business. Structured as a utility energy service, fuel cells can provide an opportunity of growth and financial support. This scenario requires a unified market and business structure between manufacturers, utilities and customers. An energy service can provide a substantial improvement to utility earnings, and a fuel cell maximizes the potential of this business by virtue of its inherent characteristics. In any business, there is a desire to grow in a profitable endeavor and a fuel cell energy service is a realistic challenge for the natural gas industry.

SoCalGas is involved with several manufacturers to bring fuel cell technology, its energy efficiency and environmental improvements to our customers. Our research and development projects must prevail in demonstrating the technology and energy services demanded by our customers in a changing energy environment. A fuel cell's ability to provide on-site electricity, thermal energy, emergency power generation, absorption cooling and high quality power for computers, with high efficiency and without emissions clearly positions it for the next century.

A fuel cell's ability to use on-site absorption cooling and dual fuel, potentially propane, as a backup emergency fuel will assist its use and expansion in power generation. Small residential generation systems are the ultimate desire and a PEM (proton exchange membrane) fuel cell may have the necessary operating characteristics to accomplish the challenging requirement. Such a system can be designed to reform natural gas for stationary use and provide the reforming for vehicle refueling with hydrogen storage during off peak periods at night. The existing debt financing structure, mortgages for homes, will allow longer repayment periods similar to utilities. The ability to creatively finance the higher capital costs of fuel cells over a longer term to realize the operating and maintenance costs will dramatically influence the commercialization and market potential.

In the distant future, the gas companies may realize a role of serving 'gas' including hydrogen to customers, reformed from the most economic feed stock. Until such time, we must examine fuel cells on a site specific basis. By fully integrating fuel cells on

a site specific basis, we can begin to appreciate the maximum opportunities derived from a truly revolutionary energy generating technology.

I quote an appropriate statement for fuel cell development and commercialization "The best way to predict the future is to create it". Fuel cells may very well be an energy technology that will allow energy generation to take place at the point of use.