Ethanol & Fuel Cells: Converging Paths of Opportunity

Prepared by Jeffrey Bentley and Robert Derby for the Renewable Fuels Association

Introduction

The energy challenges facing our Nation offer tremendous opportunities for agriculture and technology. For example, by combining fuels such as ethanol with fuel cells, farmers can be energy producers as well as consumers. The events of September 11, 2001, served as a reminder of our ever-growing dependence on oil that flows from an unstable region of the world. Meanwhile, the US is under increasing pressure to reduce greenhouse gas emissions. Recent energy supply crunches and price spikes have once again focused attention on the need to improve energy security, increase and diversify domestic energy supplies, ensure environmental quality, and modernize the nation's energy infrastructure. Ultimately, America's economic prosperity and national security depend on the availability of reliable, affordable energy.

Ethanol is a renewable resource that is playing an increasingly important role in assuring the nation's air quality, improving the economic security of America's farming communities, and addressing the challenges of homeland energy security. Similarly, ***fuel cells*** are a promising technology for efficiently and cleanly powering vehicles, homes, offices, and commercial buildings. And miniature fuel cells could someday replace laptop batteries.

Both the ethanol and fuel cell markets are the focus of major investments in technology, production, and market development. But little attention has been paid to the combination of these two powerful developments. In fact, there are major benefits that can be achieved by relatively minor shifts in focus of existing development paths to recognize and capitalize on the broad synergies that come from using ethanol to power fuel cells.

Ethanol & Fuel Cells – "The Power of 2"

- Ethanol blends seamlessly with gasoline fuels to create an improved, fuel cell fuel that is easily stored and dispensed. These blends can be varied over time, providing fuel source flexibility.
- Ethanol, a renewable fuel, used in fuel cell vehicles or for stationary power plants generates far fewer greenhouse gases than conventional fuels such as gasoline or natural gas.
- Fuel cells are extremely efficient powerplants, reducing the importance of fuel cost and leveling the playing field vs. fossil fuels.
- Ethanol's distribution infrastructure is complete to the terminal level, meaning that only very limited investment in local distribution could enable ethanol to power fuel cells for remote residences and cell towers far from the electric grid.
- Unlike other fuel cell alternative fuels like hydrogen or methanol, ethanol has a very positive environmental, health, and safety footprint with no major uncertainties or hazards.
- The technology to use ethanol in fuel cells already exists and has been demonstrated. Only minor changes are required to existing systems to introduce ethanol as a fuel cell fuel.

This paper presents a vision of how ethanol and fuel cells can be combined to create significant synergy, reaching markets and bringing benefits that are ***not*** achievable with any other fuel or with any other power technology. In the pages ahead, we will describe these benefits and present a roadmap for how these synergies can be developed in an effective and stepwise fashion through contributions from the ethanol, fuel cell, automotive, and utility industries along with support from state and federal governments. The basis or platform for this vision is the existing, ongoing investment in ethanol and fuel cell markets, which has already been committed by government and industry.

As outlined in this paper, we believe ethanol fuel cells merit a higher degree of focus of ***existing*** government program resources because the societal benefits are broad and pervasive, such as lowering emissions, improving air quality, increasing energy security, and creating economic opportunities.

For private entities investing in fuel cells and ethanol production, a focus on ethanol fuel cells will expand and diversify markets. With relatively minor further investment, ethanol used in fuel cells will create substantial financial opportunity, energy independence, and environmental progress for the US.

Ethanol: A "Flexible Fuel" Coming of Age

Ethanol produced from the starch in corn and other feedstocks has been successfully used for decades as a transportation fuel in the US and many other parts of the world. Ethanol's technical features are strong – it is an energy-dense liquid so it stores compactly, and it contains 35 percent oxygen, so it aids in clean combustion. Because it is domestically produced, ethanol can directly displace imported oil and petroleum products, contributing to US energy security, and it provides economic support and alternative markets for agricultural crops. When ethanol is substituted for petroleum, the environmental benefits include lower CO_2 and tailpipe emissions. And unlike other oxygenates, ethanol is not harmful to the environment in the event of a fuel spill or leak.

> *"Recent breakthroughs in [enzyme technology] and processing are radically changing the viability of ethanol as a transportation fuel."*
>
> **Senator Richard Lugar (Indiana) & James Woolsey, Former Director of Central Intelligence Agency**

Because of these attributes, ethanol has a strong future as an alternative fuel or fuel additive for internal combustion engines. The demand for ethanol is growing and the ethanol industry has responded with improved, more efficient production technology, greater production capacity, and a significantly broader distribution infrastructure that now includes most of the pollution-challenged areas of the US.

With the prospect of a strong market base for ethanol as a gasoline additive, the ethanol industry is now starting to build the foundations for a greater role in future markets. In these future markets, ethanol's technical, economic, and environmental attributes can be even more important. For example, ethanol, when used in fuel cells, can make important energy and environmental contributions and open up new markets in distributed generation and advanced transportation applications.

Policy & legislation

A renewable fuels standard in which a small percentage of our nation's fuel supply is provided by renewable, domestic fuels provides a positive roadmap for increasing energy security and stimulating rural economies. For instance, ethanol availability and infrastructure will increase dramatically. In 2001, ethanol use was a record 1.8 billion gallons. The Renewable Fuels Standard (RFS) would gradually increase the use of renewable fuels such as ethanol by 0.3 to 0.4 billion gallons per year (bgy), reaching 5.0 bgy by 2012. This increase in demand will require a substantial investment in new ethanol production facilities – an investment that largely will be made in the nation's rural communities.

According to a study completed for the US Department of Energy (DOE), the RFS will result in the conversion of more than 200 additional terminals to ethanol use. To establish the infrastructure at the terminal level for other fuels would require a tremendous capital expenditure.

Benefits of an RFS

An RFS that grows to 5 billion gallons of ethanol by 2012 would have a significant impact on both the farm and overall economy over the next decade:

- Reduce crude oil imports by 1.6 billion barrels.
- Reduce the US trade deficit by $34 billion.
- Create 214,000 new American jobs.
- Increase US household income by $51.7 billion.
- Create $5.3 billion in new investment in renewable fuel production facilities.
- Increase demand for grain (mainly corn) an average of 1.4 billion bushels and soybeans 144 million bushels.

Source: AUS Consultants, Inc.

Infrastructure

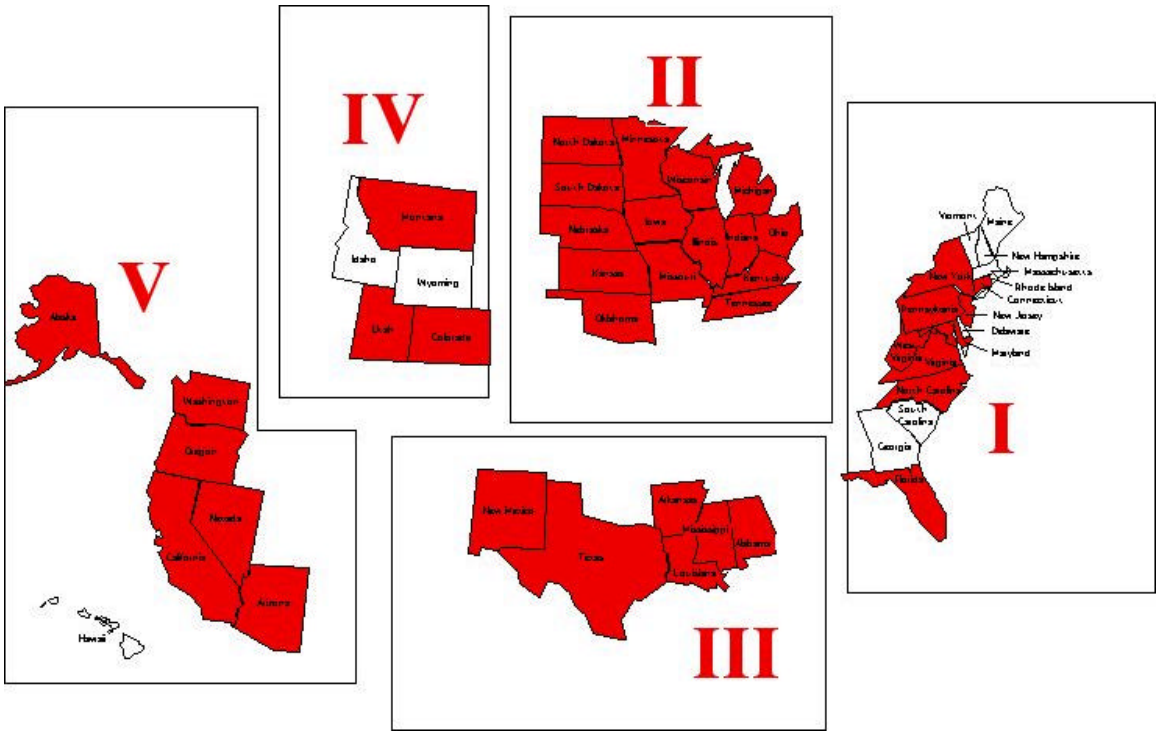
Fuel infrastructure has been identified by the automobile manufacturers as one of the most critical issues in determining the choice of fuel for fuel cell-powered vehicles because it presents the most expensive component of the program. Ethanol presents several advantages over other fuel sources because the infrastructure is already in place. In fact, the ethanol infrastructure is second only to gasoline as a passenger car fuel. In addition, ethanol is currently distributed by rail, barge, and truck for use on a nationwide basis as an octane enhancer or oxygenate blended with gasoline. As such, ethanol's infrastructure to the terminal level is complete and the gasoline industry has experience handling and blending ethanol. As shown in *Figure 1*, ethanol is already marketed in the majority of states throughout the nation.

At the service station, ethanol can be dispensed in the same manner as gasoline, with very minor modifications to the dispensing equipment. In many cases, existing tanks could be used for ethanol, which may not be the case with other alternative fuels. Because ethanol is already distributed from existing terminals, industry has already developed materials (such as seals, valves, etc.) that are compatible with ethanol.

Supply

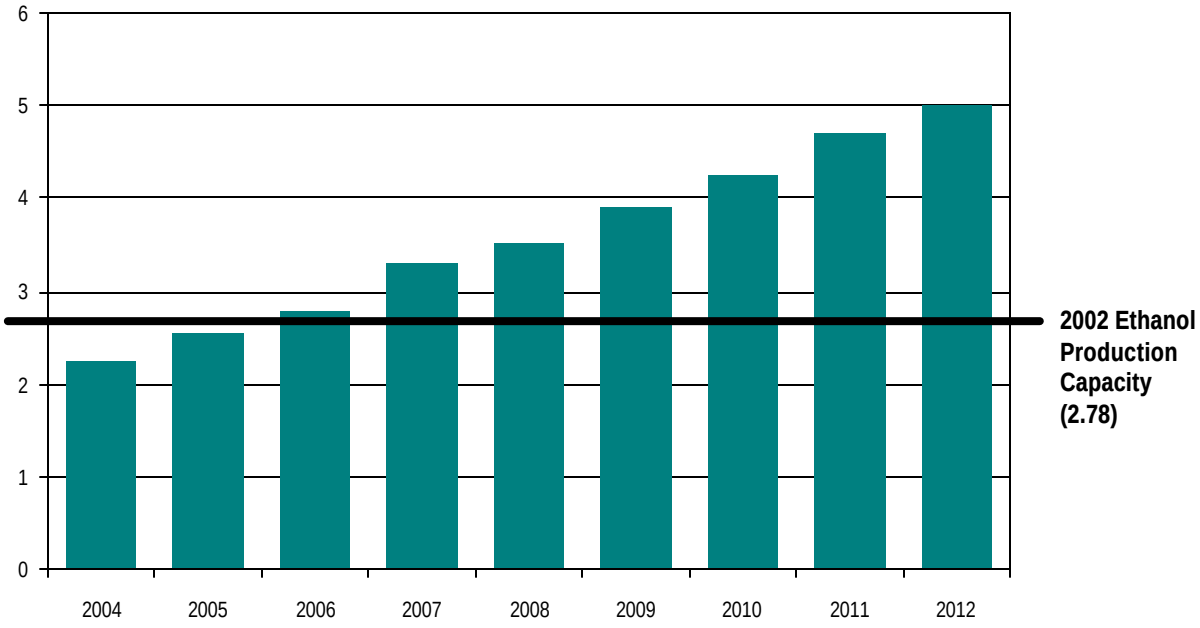
Today, ethanol production facilities located in 20 states across the country have the capacity to produce more than 2.5 billion gallons of ethanol per year, and new facilities under construction and expansions will increase capacity to 2.8 billion gallons by the end of 2002. Because ethanol production facilities are largely modular, expansions can be done quickly by simply adding new equipment to existing production facilities as needed to meet demand. *Figure 2* shows the production increase requirement under the RFS legislation.

Figure 1: States with Ethanol Sales in Year 2000*



Source: FHA Table MF-33e

Figure 2: RFS Requirements (bgy)



Source: Downstream Alternatives, Inc.

Breakthroughs in enzyme technology and processing are increasing the viability of ethanol production from diverse, low-cost feedstocks. Future generations of ethanol production facilities will include production from cellulosic biomass feedstocks, such as corn stover, rice straw, and forestry residues. Conservative estimates from Oakridge National Laboratory predict ethanol production from cellulose feedstocks may reach 3 - 4 billion gallons a year in 10 years, which is in addition to grain-based ethanol production. The estimate grows to 8 billion gallons a year from cellulosic feedstocks alone in 20 years. That equates to powering at least 10 million fuel cell vehicles with ethanol in 10 years, and 20 million vehicles in 20 years. Best-case scenarios project substantially higher numbers.

Cost

Because of ethanol's outstanding economic and environmental benefits, the federal government has implemented near-term incentives that make ethanol competitive with gasoline. In the long term, ethanol's cost competitiveness as a fuel for vehicles and distributed power plants will come from three factors:

1. Lower production cost (lower cost feedstocks such as cellulosic crops)
2. Higher utilization efficiency (fuel cells operating at 45 to 60 percent efficiency)
3. Recognition of the societal benefits of renewable power (state utility renewable power requirements, which favor fuel cells and ethanol)

Fuel Cells: A Technology on the Rise

Fuel cells are similarly positioned to contribute significantly to energy, economic, and environmental challenges that face the US. Following several decades of R&D and application in spacecraft, first-generation fuel cells are now producing reliable power for distributed generation applications around the world. Several types of more-efficient, lower-cost, second-generation fuel cell technologies (e.g., proton exchange membrane, solid oxide, and molten carbonate) are being demonstrated by automakers and utilities in a far broader set of applications. And at least one company is developing miniature, new-generation direct-ethanol fuel cells capable of replacing batteries in laptops and similar devices.

How fuel cells work

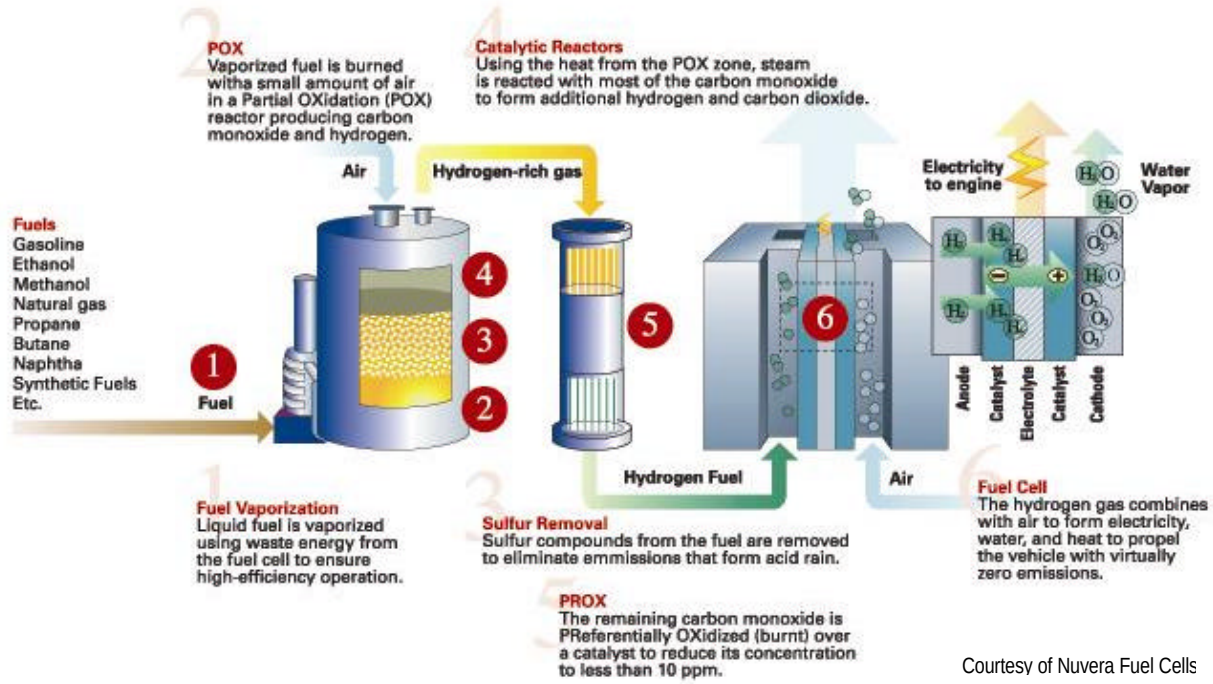
Fuel cells work by combining hydrogen and oxygen in a chemical reaction to create electricity, without the noise and pollution of conventional engines. In principle, a fuel cell operates like a battery. Unlike a battery, however, a fuel cell does not run down or require recharging. It will produce energy in the form of electricity and heat as long as fuel is supplied. Because the fuel cell relies on chemistry and not combustion, emissions are much lower than those from the most efficient internal combustion engines and consist primarily of water and steam.

> *"EPA is excited about the potential for fuel cells to be the long-term solution for reconciling transportation and the environment."*
>
> **Margo T. Oge, Director**
> **Office of Transportation & Air Quality**
> **Environmental Protection Agency**

Fuel cells offer a unique combination of efficiency and ultra-low emissions, which is why every major automaker has a fuel cell development program in place. Many of these fuel cell programs involve hundreds of millions of dollars and hundreds of

engineers. Moreover, some automakers are hedging their investments by developing systems capable of converting hydrocarbon and renewable fuels into hydrogen to power fuel cells (see *Figure 3*). For example, General Motors, Toyota, VW, and Renault, along with fuel cell technology developers such as United Technologies and Nuvera Fuel Cells, are developing gasoline fuel processors for automotive fuel cell applications. In fact, GM has already demonstrated a truck powered by a fuel cell operating on gasoline.

Figure 3: Integrated Fuel Processor and Fuel Cell Stack



Courtesy of Nuvera Fuel Cells

Adding fuel-processing technology to the front-end of a fuel cell system has become far less complex over the past few years. Comprising about 30 percent of the system, fuel processors, like fuel cell stacks and power conditioners, require only slight modifications to adapt to various gaseous and liquid fuels. And for some fuel cell technologies, such as solid oxide fuel cells and direct ethanol fuel cells, converting ethanol into clean power is a much simpler process.

Market drivers

In the last decade, the set of challenges to the energy and transportation markets has broadened, creating market opportunities for fuel cells. For example:

- There is continuing pressure to reduce the environmental impacts of transportation and utility power. Tailpipe and smokestack air toxic emissions regulations continue to be tightened in an effort to maintain the nation's air quality.
- There is a need to find renewable alternatives to the combustion of coal, natural gas, and petroleum as other parts of the world call on the US to reduce its inordinate share of greenhouse gas emissions. In the transportation sector, these combined pressures have resulted in a response such that every automaker in the world has a significant fuel cell vehicle development effort since this is the most promising technology for simultaneously reducing air toxic emissions and reducing

automotive CO_2 emissions. And in California, the Governor recently signed a bill into law that requires cuts in tailpipe emissions of greenhouse gases by cars and light trucks.

- In the post-September 11 era, US energy imports, which traditionally has been seen as just a trade issue, now have a clearly negative domestic security impact as well. Increasing the supply of domestically produced energy reduces our reliance on petroleum imported from unstable or unfriendly portions of the world. And as the security vulnerability of major infrastructure elements (including power plants) is scrutinized, it has become clear that a distributed or dispersed energy generation capacity will enhance domestic security.
- A trend toward distributed generation as a response to the need for more:
  - Reliable, dependable power
  - Available power for remote sites
  - Agricultural power for hog farms, etc.
  - Independent power, or "home grown" power

Recent developments

As a result of major government and commercial investments over the last decade, the fuel cell industry expects significant improvements in the viability of fuel cells for all applications. *Figure 4* below shows the trend for small stationary fuel cells.

Figure 4: Expected Cost and Efficiency Improvements for 5kW Stationary Fuel Cells (2002 – 2010)

	2002		2004		2010
Fuel Cell Cost (5kW)	$50,000	→	$15,000	→	$3,000
Efficiency	30%	→	35%	→	45-60%

Source: Fuel cell industry interviews

These improvements are key to fuel cell penetration of major markets. For example, today's fuel cell cost structure, which is a result of the prototype volumes being produced, means that fuel cells are still too expensive in all but very unique applications. But when the industry achieves the targets shown for 2004, fuel cells could economically power homes and cellular telephone sites, which are off the electrical grid, competing with engine generators and solar cells.

Similarly, the improvements targeted for 2010 will result in stationary power fuel cells that compete head-on with grid power in states such as California and New York. Achievement of lower cost targets will enable low-emission fuel cell automotive powerplants that provide 80 mpg or greater, with no loss in vehicle performance or function.

Of potentially greater significance, stationary fuel cell applications are enjoying increasing success. For example:

- UTC Fuel Cells has delivered and installed more than 200 of their 200kW fuel cell systems throughout the US and 14 countries, generating over 5.25 million kW hours of electricity with high reliability and availability.
- Plug Power has manufactured more than 300 integrated residential fuel cell systems, accumulating over 300,000 hours of operational time.
- H-Power, teamed with Rural Electric Cooperatives, has installed fuel cells in homes and other remote applications. The H-Power fuel cell operating in Yellowstone National Park is a dramatic testimony to the environmental attractiveness of fuel cells.

Federal support

Lastly, in 2002, the Bush Administration announced that the "Freedom CAR Initiative" – a hydrogen-based fuel cell vehicle program – will involve spending $150 million in 2003 for fuel cell vehicle R&D and infrastructure. And to bolster development of highly efficient solid oxide fuel cells, the US Government is playing a significant role by funding a 10-year, $500-million effort to produce fuel cells that can break current cost barriers. Once the costs of such systems are driven down, DOE says the low-polluting technology will have a strong foothold and an open door to widespread use. The companies involved in this program include:

- Honeywell, Inc.
- Siemens-Westinghouse Power Corp.
- The team of Delphi Automotive Systems and Battelle
- The team of Cummins Power Generation and McDermott Technology Inc.

Where the Paths Merge: Ethanol-Powered Fuel Cells

California Fuel Cell Partnership 2002 Goals*

- Operate 20 California Fuel Cell Partnership vehicles, together accumulating 60,000 miles (already 16 fuel cell vehicles are committed to the partnership's effort).
- Install a satellite hydrogen filling station in Richmond, California, as well as 2 additional hydrogen stations at appropriate locations.

*Partial list

Source: California Fuel Cell Partnership

Fuel cells require a source of hydrogen to produce electricity. But hydrogen is difficult to transport and store. As a result, applications that use large volumes of fuel generally require on-site hydrogen generation plants, as described in *Figure 3* above. Moreover, in the US today, there is no hydrogen infrastructure to support a growing fuel cell market.

Ethanol is a hydrogen-rich liquid, which overcomes both the storage and infrastructure challenges of hydrogen for fuel cell applications. There are no technical barriers to the use of ethanol in fuel cells. Because ethanol is far easier to transport and store than hydrogen, fuel reforming – which uses a chemical process to extract hydrogen from fuel – offers a practical solution to the challenge of providing hydrogen to fuel cells onboard vehicles or for remote or stationary applications. In addition, ethanol is easier to reform than gasoline and most alternative fuels because of its relatively simple molecular structure.

Automotive applications

In California, industry and government teamed to form the California Fuel Cell Partnership (CaFCP) to conduct near-term demonstrations of fuel cell vehicles. A major focus of the partnership is to evaluate and demonstrate the viability of the ***alternative fuel infrastructure technology*** for fuel cell vehicles.

The fuels assessment study released by the Partnership in October 2001 presented the following conclusions about ethanol as a fuel for fuel cell vehicles:

- A ***"major advantage"*** of ethanol is its compatibility with gasoline reformer technology and its flexibility to be used neat (i.e., only ethanol) or in a range of gasoline/ethanol blends.
- Flexibility, combined with ethanol's compatibility with the gasoline infrastructure, means that ethanol can be optimized regionally and according to ethanol economics and availability vs. gasoline. This is the only proposed fuel cell vehicle fueling strategy that does not require the commitment of major infrastructure investments to a single fuel.
- An ethanol reformer could be simpler, more reliable, and less costly than a gasoline/multifuel reformer, increasing ethanol's attractiveness as a neat fuel for fuel cell vehicles.

As the favorable cost, environmental, and energy security benefits of using ethanol in fuel cells have achieved greater recognition, industry has followed suit by taking action. For example:

- US DOE and the Illinois Department of Commerce and Community Affairs partnered with Caterpillar, Nuvera Fuel Cells, and Williams Bio-Energy to design, fabricate, and demonstrate the nation's first commercial ethanol-powered fuel cell system. The 13kW ethanol-fueled PEM stationary fuel cell system will power William's security office and visitor's center in Pekin, Illinois.
- PSA Peugeot Citroën has made biofuels one of its main avenues of research. Produced from grain or sugar beet crops in the case of ethanol, or from oil-bearing plants such as rapeseed and soybeans in the case of oil methyl esters, biofuels are essentially renewable energy sources. In addition to their substantial contribution to attenuating the greenhouse effect, these fuels offer environmentally friendly performance, notably by reducing particle emissions.

Such liquid-fueled fuel cell vehicles will take most of this decade to commercialize. However, in the near-term, automakers and partnerships like the CaFCP will be demonstrating fuel cell vehicles operating on hydrogen that is stored on-board the vehicle. In fact, the first fuel cell vehicles to be placed into fleet demonstrations will operate on hydrogen. For instance, Toyota recently announced it will start limited marketing of a fuel cell hybrid (FCHV) sport utility vehicle (SUV) in Japan and the US near the end of 2002 – much earlier than it originally

Driving on Ethanol

- An ethanol fuel cell vehicle (FCV) will emit about 13% of the tailpipe pollutants compared with a gasoline vehicle and less than half the pollutants of even a gasoline hybrid vehicle.
- Greenhouse gas emissions from an ethanol FCV would be substantially less than even an advanced vehicle using a gasoline internal combustion engine. The ethanol FCV contributions to greenhouse gases could be close to zero if cellulosic biomass is used for the ethanol feedstock.
- Unlike hydrogen and methanol, ethanol poses no unique or potentially "show-stopping" health and safety hazards.
- Unlike other fuel cell alternative fuels like hydrogen or methanol, ethanol has a very positive environmental, health, and safety footprint with no major uncertainties or hazards.

Source: Based on 2001 California Fuel Cell Partnership Study

planned. The earlier launch reflects the successful results of a year of testing in the two countries of the FCHV-4 prototype and Toyota's response to society's expectations for cleaner mobile solutions. These prototypes will operate on hydrogen and be tested by select private sectors, technology-related companies, and institutional organizations that have access to a hydrogen-supply infrastructure.

These vehicles and their hydrogen fuel will initially be very expensive. However, states like California and automakers such as Toyota are committed to these demonstrations. The most likely areas for demonstrations are pollution-plagued states where ethanol is already available, playing a role as a clean fuel additive. Ethanol can be used as the primary fuel for making hydrogen at the filling stations that support these demonstration fuel cell vehicles. Used in this fashion, the hydrogen would be renewable and the vehicle would be completely emission-free, creating a powerful demonstration of the environmental benefits of ethanol and fuel cells.

Fuel source diversity is an important factor in transportation and stationary power generation. In stationary power, natural gas will be the preferred fuel, where it is available. However, the natural gas infrastructure does not extend to all areas, nor is its supply completely assured. In its strategic plan for developing the distributed generation industry in California, the California Energy Commission recently laid out the following policy objectives:

> ***Diversify Energy Sources*** *–"While diversifying among different technologies, be aware of the potential risks of concentrating on one or a few fuel sources (e.g., natural gas). Limit fuel source risk by diversifying among technologies that utilize different fuels or can utilize multiple fuels."*

Ethanol can play an important role in distributed generation by supplementing natural gas for fuel source diversity and as a portable, distributed fuel that is available in areas beyond the reach of the natural gas infrastructure.

"… 9 states have adopted renewable energy portfolio standards for retail electric providers, essentially mandating some investment in new renewable technologies."

Good Company Associates

Distributed power

Distributed generation is a growing trend in the utility industry. Locating the production of power close to the demand increases power options for homes and businesses. Just as new technologies such as wireless phones and the Internet have increased our flexibility to work and live in remote locations, distributed generation based on ethanol will create new energy options for remote fuel cell power systems.

Fuel cells powered by ethanol will have very low emissions, noise, and environmental footprint. And, as seen by H-Power's propane powered demonstration in Yellowstone, they are able to be sited virtually anywhere, even in the most environmentally sensitive areas.

With recent population shifts toward ruralization and suburbanization, more homes are being constructed far from city centers, beyond the reach of electrical grids and natural gas mains. Rural electric cooperatives and other utilities serving remote areas face significant challenges extending and maintaining the grid to provide electrical service to these remote residential customers. Other remote loads include cell towers.

For these distributed generation applications, fuel cells powered by propane are already in use, such as H-Power's fuel cell system in Yellowstone. With the development of a modest distribution infrastructure to distribute locally produced ethanol to generation facilities at homes, small businesses, farms, and other remote loads, ethanol can also be used for these applications, creating regions of energy self-sufficiency.

A plant of typical size, producing 40-million gallons of ethanol per year, can make enough ethanol to power 30,000 average residences. In addition to the energy security and environmental benefits, such an average-sized plant would also expand the economic base of the local economy by $110 million and create local jobs and tax revenue. The war on terrorism has renewed interest in reducing energy imports and diversifying the energy sector.

> *"73 percent of Americans believe the US should develop new energy sources to diminish its dependence on Mideast oil supplies."*
>
> **Newsweek Poll, November 2001**

Policy & legislation

Many states, including California, Texas, New York, Connecticut, and Massachusetts, have incentives or requirements for a percentage of electricity to be produced from renewables. Fuel cell technology is commercially available for stationary applications from a few manufacturers at present, although many more companies have products nearing final production. Tax credits or deductions are a common means through which states provide indirect incentives to individuals or businesses for adopting new technologies with perceived public benefits.

For example, 34 of the 50 states offer one or more tax incentives for installation of renewable energy devices. Other states offer incentives for energy efficiency investments. Currently 19 of the 22 states that have formally adopted utility restructuring programs offer constituents incentives to encourage investment in energy efficiency or renewable energy technologies. In addition, 9 states have adopted renewable energy portfolio standards for retail electric providers, essentially mandating some investment in new renewable technologies. Similar incentives would be a likely means for supporting the early commercial deployment of fuel cells as well. In fact, 7 of the state portfolio standards allow fuel cell installations to count toward achieving renewable energy portfolio requirements in some form.

> *"America cannot have homeland security without energy independence."*
>
> **President George W. Bush**

The Road Ahead: A Call to Action

The ethanol industry has recognized the significant role that fuel cells can play in the long-term viability of the industry. ***The Renewable Fuels Association (RFA),*** through its ***Fuel Cell Task Force*** seeks to engage stakeholders from the automotive, utility, fuel cell, and government communities. The objective is to develop a common vision of the role that ethanol can play in the developing fuel cell industry. The Task Force envisions an ethanol market that is financially rewarding for commercial participants while contributing to the public policy objectives of the governmental stakeholders.

> *"The outlook for ethanol has never been brighter. Demand for clean-burning, domestic, renewable fuels is at an all-time high, and the US ethanol industry is rising to the challenge."*
>
> **Bob Dinneen**
> **President & CEO**
> **Renewable Fuels Association**

Near-term actions that will be undertaken by the ethanol industry include:

1. Raise stakeholder awareness of ethanol fuel cells by developing and disseminating additional information, such as:
   - Economic analyses to define markets where ethanol fuel cells can be commercially competitive, especially in distributed generation
   - Ethanol supply, economics, and infrastructure development status
   - Progress of ethanol fuel cell demonstrations
2. Initiate discussions with the fuel cell industry (including all fuel cell technologies) with the objective of identifying companies willing to include ethanol in their technology and market development plans.
3. Initiate discussions with the hydrogen supply industry and other stakeholders involved in developing the early infrastructure to support hydrogen fuel cell vehicle demonstrations in California and other areas. Working with these stakeholders, define the technical and economic feasibility of building an ethanol-hydrogen fueling station.
4. Initiate discussions with the automotive industry to gain further acceptance of the use of ethanol as a neat fuel or blended with gasoline in fuel cell vehicles.
5. Work with the US DOE and other federal agencies to tailor existing technology development and demonstration programs to the use of ethanol.
6. Work with state and local governments to define the role that ethanol can play in renewable power programs.

In the medium-term, these activities are expected to lead to additional demonstrations and market development programs focused on those markets with industry and government support. The ethanol industry has already committed the financial resources to expanding the supply of ethanol and has undertaken early efforts to develop the ethanol fuel cell market. It is our hope that other stakeholders will respond to our vision and work with us to define a role for ethanol that creates significant public value by contributing to environmental and energy security while creating economic opportunity for farmers, ethanol fuel providers, and their partners in the automotive, power, and fuel cell industries.

The RFA Fuel Cell Task Force

Mission

As members of the Renewable Fuels Association's Fuel Cell Task Force, we seek to promote the advantages of renewable ethanol as a fuel source for fuel cells, which offer significant promise in reducing fossil fuel use and increasing energy efficiency. In doing so, we also seek to advance ethanol fuel cells in all practical applications including mobile and stationary power. The RFA is an active member of the U.S. Fuel Cell Council.

For more information, contact:

Mary Giglio
Director, Congressional & Public Affairs
Renewable Fuels Association
One Massachusetts Ave., NW, Suite 820
Washington, DC 20001
T) 202-289-3835
F) 202-289-7519
mgiglio@ethanolrfa.org
www.ethanolRFA.org

Fuel Cell Task Force Members

- Jeff Oestmann, Cargill Inc. (Chairman)
- Randall Doyal, Al-Corn Clean Fuel
- Charles Corr, Archer Daniels Midland
- Jacki Fee, Cargill Inc.
- Robert Reynolds, Downstream Alternatives Inc.
- Glenn Kenreck, GE Betz
- Jeff Roskam, ICM, Inc.
- Philip Shane, Illinois Corn Growers Association
- David Loos, Illinois Department of Commerce and Community Affairs
- Neil Koehler, Kinergy, LLC
- Duane Adams, Minnesota Corn Growers Association
- John McClelland, National Corn Growers Association
- Todd Allsop, New Energy Corp.
- Gary Welch, Williams Bio-Energy
- Mary Giglio, Renewable Fuels Association

Disclaimer

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