Benefits of Fuel Cell Power

A Study of Fuel Cell Powered Cell Towers

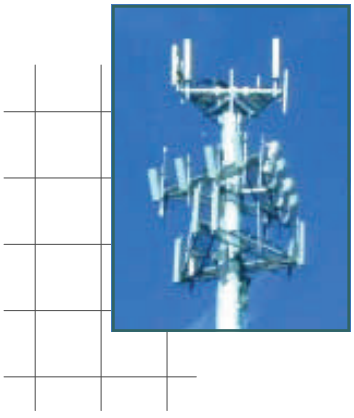
Development of a Business Model for Implementation

December 1, 2005

Cover Courtesy of US Department of Energy

Preface

This study was commissioned by Altergy Systems to identify and examine the tax benefits possible for a telecommunications company that desires to transition to the use of fuel cells as backup/primary power in the day-to-day operations of a distributed communications system. Included in this study is an overview of a state-by-state and federal incentives for fuel cells. This multipurpose study examines how to best backup the energy infrastructure for cell sites. It also addresses the critical issue of being able to survive potential vandalism/terrorism through a hardening design of the onsite power component.



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Executive Summary

Behind every smoothly running wireless network is an increasingly fragile power infrastructure. The complete loss of power to a geographic area creates many challenges to the reliable operations of that network. Thus hardening and protecting a local power supply for cell towers is not only necessary, but essential. This can only be accomplished by onsite electrical generation.

Onsite power backup mandates supplies of stored chemical, mechanical, or electrical energy dispatched through a hierarchy of control. Although diesel generators are often the first thought for backup power, they have many faults that make them an unattractive technology. Batteries remain the overwhelming favorite to ride through short outages, however, they too have many downsides, least of which is end-of-life disposal. One of the most important and least appreciated challenges in the critical backup arena is just how robust and resilient the technology is—how reliable, not necessarily how expensive.

Solid state power generation has evolved to the point of commercialization. This solid state device, a fuel cell, uses hydrogen directly generating DC power electrochemically with water as the only by-product. Fuel cells for backup and primary applications are designed for reliable operation in a very broad temperature range. The fuel cell provides immediate and extended response to power interruptions and are lightweight making them suitable for rack-mounting and rooftop installations. The clean process produces zero emissions, no thermal signature or noise, and are easily monitored and controlled with off-the-shelf automation packages.

The fuel cell technology has widespread support within both state and federal government. Just as important, companies like Altergy Systems have been designing fuel cells specifically for stationary applications avoiding the uncertain path of innovation taken by many other manufacturers of technologies. To encourage the refinement and help drive down the end-cost of the fuel cell, many states and the federal government have provided an economic stimulus for capital formation. This report lists the states with such incentives and programs along with a summary of the recently passed 2005 Energy Policy Act. The focus of the analysis is development of a business model which can be used as a template for a nationwide rollout for full economic wring-out of available governmental benefits.

It is assumed Sprint-Nextel will use the fuel cell as a backup technology, however, this report takes the next step investigating the fuel cell for primary power under a 3rd Party who would deliver power and make the capital investment. If implemented, this scenario eliminates the risk of investment and delivers real-world experience of using fuel cells prior to a nationwide rollout of the technology. Under this program Sprint-Nextel would create a window-of-opportunity to examine a risk-free prove-out of concept. Assuming an overall success of the program, they could then choose to keep installing backup systems, or to use the fuel cell for primary power as some in the banking industry have already done.

The 3rd Party business model developed in this report consists of 100 select cell tower sites in California. The sites chosen are with high power rates, an at-risk overworked utility grid, power quality issues, attractive state incentives, and the support from the highest levels of state government. Pacific Gas & Electric is receptive to this demonstration program and embraces the technology as does the California Public Utilities Commission. Each site is assumed to have a connected load of 20 kW and the system is designed for grid interconnection. The California Emerging Renewable buy-down incentive of $3.20 per watt is available resulting in a $64,000 rebate assuming the hydrogen is derived from renewable sources. Coupled with the Federal Investment Tax Credit incentive of $1,100 per kW adds $22,000 in reducing the capital cost. Fuel cells qualify for a 5-year accelerated depreciation.

The findings of this study conclude that fuel cells are best suited to meet the long-term energy needs of telecom cell sites while reducing the future liability of batteries and diesel generators. Moreover, the PEM fuel cell is the best technology with an ability to dispatch power at-will instantaneously. The Altergy Systems integrated fuel cell system has the ability to not only dispatch power at-will, but it can also provide a load-shedding component through the Internet based control system.

Fuel Cells; A Case for Powering Cell Towers

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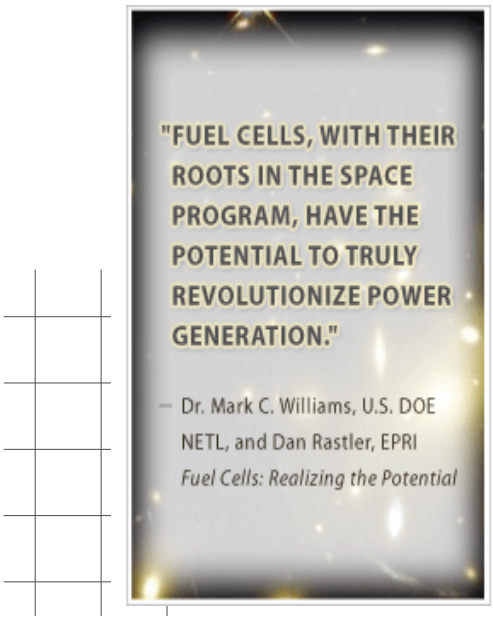
1. Introduction

Often underreported is the fact that state governments in the United States collectively offer scores of financial incentives and favorable regulatory policies that promote fuel cell deployment. These states offer a creative array of financial incentives to encourage the manufacturer and installation of stationary fuel cells. Their programs include industry recruitment incentives, corporate tax credits, net metering policies, grants, loan programs, rebate programs, personal tax credits, sales tax exemptions, property tax exemptions, and often production incentives.

This report will review the many states that offer fuel cell related tax credits and benefits of all types to attract employment opportunities and economic development within those states. Actual negotiations with the state's economic development department may yield additional benefits. It is however, fully dependent on many factors. This report will also present state-level incentives and policies encouraging the development and adoption of stationary fuel cells. As an adjunct, it will present an economic analysis of deployment of fuel cells in a select area of California as a microcosm of a much larger nationwide potential.



The issues of energy security and terrorism is first and foremost in creating a grid impervious to most threats. Installing Distributed Generation (DG) adds to grid reliability and helps insulate the end-user on a level similar to the reliability of many nodes and servers found in the Internet architectural infrastructure—which is a distributed system. Finally, this report will review the multitude of hydrogen programs across the US and their direct linkage to the fuel cell.

1.1 Background

Historically, power conversion began with on-site installations such as water wheels located on rivers to drive machinery, or windmills pumping water or grinding grain into flour. By the early 19th Century, on-site steam powered engines had been introduced to drive machinery. By the late 19th Century, the development of steam turbines, electrical generators and motors led to the introduction of large-scale off-site power generation. The development of AC power transmission allowed electricity to be transmitted over longer distances to distant customers. As the 20th Century began, big power stations provided power to factories and buildings at higher efficiency and at a lower cost than labor-intensive on-site thermal power production.

As the 20th Century closed, advances were made in small onsite power generation technologies which included the development of new technologies. One such technology was the early fuel cells in the 1990's which are now a reliable commercial product. The 21st Century is poised with the motive power of an efficient fuel cell without the associated pollution of the prior two centuries. There are several other compelling drivers pushing this technology forward.

The driving factor behind all these developments are the fact that electricity is an important commodity that keeps our modern society functioning. Imagine if you will a world without electricity. There would be no telephone switches, wireless cell towers, bank computers, police/fire communications networks, hospital emergency rooms, air traffic control, or street lights. The electrically operated valves and pumps that move water, oil and gas would not function either. Society itself would come to a complete and devastating halt. This leads to a discussion of other related issues—the electricity infrastructure.

There are a couple of areas that come to mind when thinking about current affairs in the energy arena: greenhouse gases, energy security, energy efficiency, and fuel cells—all not necessarily in that order. When speaking of greenhouse gases, the beneficial impact of fuel cells on the environment cannot be ignored since they are intrinsically linked. A component of energy security implicitly includes risk management. However, another area which has taken center stage for most states is the high-cost of energy and the chronic condition of disarray of the energy infrastructure. The utility grid infrastructure has hardly been maintained, much less upgraded for almost 30 years. This confluence of happenstance presents many opportunities for those visionaries with the abilities not only to recognize, but to act.

According to the United States Department of Energy, the US is more *energy-dependent* than any other country in the World. With only 4.6 percent of the world's population, the United States consumes 24.0 percent of the world's energy. The United States ranks first in annual petroleum consumption (25.4 percent) and natural gas consumption (25.0 percent), and ranks second only to China in coal consumption.

Critical problems associated with fossil fuel dependency and energy inefficiency are increasingly evident to governments at all levels, both domestic and abroad. Many governments are taking aggressive actions to address and counteract these problems, which include short-term and long-term environmental degradation, air pollution effects on public health, global warming, and a variety of political and economic consequences and risks associated with the procurement and use of fossil fuels. National security concerns also have been a prime motivator for the energy policy re-examination.

With approximately 60 percent of the oil utilized in the US being imported, often from countries openly hostile to the United States, seeking alternative energy sources has become a prime concern for national security. With the increased involvement of the government and utilities in renewable energy as a means of strengthening energy security, the scope of protection has expanded. Solidifying and developing domestic energy production and protecting the existing energy infrastructure is a national security priority. Protection against threats such as terrorism and strengthening the military is an obvious priority.

The Department of Homeland Security and the Department of Defense has recently extended their purview to include protection against possible power disruptions caused by natural disasters or system related failures. There are numerous events that could potentially leave the country in a vulnerable position with crippling power disruptions as was experienced in the East coast blackout in 2003 and including the recent devastating hurricanes Rita, Katrina, and Wilma. Total failure of the utility grid is not a new phenomenon in the US even without natural disasters. It has happened many times in recent history. For example, in 1996, "Western states lost power because of line sag; a squirrel provided a pathway of high voltage to ground, and was instantly vaporized on one of the transformers at a crucial time" (Rocky Mountain Institute 8-14-03). In 1998, there were two power failures: ice storms took out power from eastern Canada and the U.S.

Consequences of August 14, 2003, Blackout

- **1** Canadian Province affected
- **3** deaths attributed to the blackout
- **12** airports partially or completely closed
- **259** power Plants shut down
- **700** flights cancelled nationwide
- **9,266** square miles affected
- **61,800** MW of power lost
- **1.5 million** Cleveland residents without water
- **50 million** people affected
- **$4.5—12 billion** in lost economic activity

Source: North American Electric Reliability Council

Figure 1

To get to the point, at the transmission level of the utility grid, over the past 30 years, few have noticed the lack of investment in the infrastructure of California, making it susceptible to a possible disruption. California is extremely vulnerable on the supply side of generation. These two critical issues met in a geopolitical confluence manifesting itself in May of 2000, just over two years after California restructured the monopolistic electricity market to a competitive energy market.

First indications of a pending electricity crisis started to emerge. During this time, shortages in electrical supply put the reliability of the entire grid system in jeopardy. The California Independent System Operator (CalISO) located in Folsom California, issued 32 Stage-1 and 16 Stage-2 Emergency Notices during four summer months of 2000. Rolling blackouts ensued and areas of the power grid were cycled off as determined by individual electric utilities. Their emergency plans were to simply keep power off in a given area for an hour to 90 minutes and then rotate to another geographic region. Post-blackout estimates of rolling blackouts and Stage-3 alerts cost Californians $1.7 billion in lost wages, sales, and productivity, and up to $12.0 billion in lost economic activity which threatened to slow down an already weakened national economy (Figures 1 & 5). This was an unprecedented event in the history of California, which ultimately lead to political upheaval and the removal of a governor. Aside from that, Southern California is still experiencing rolling blackouts as recently as August 2005.

To meet this demand, capital investments in upgrades and new transmission lines must increase from

their current level of $3 billion annually to roughly $5.5 billion annually over the next 10 years (Fama, 2004, p. 18). Illustrating the dire need for energy in California, Senator Tom McClintock stated "California must add 30,000 megawatts of new electric power generating capacity over the next ten years." Figure 2 bolsters his statements by showing the lack of investment in the delivery system.

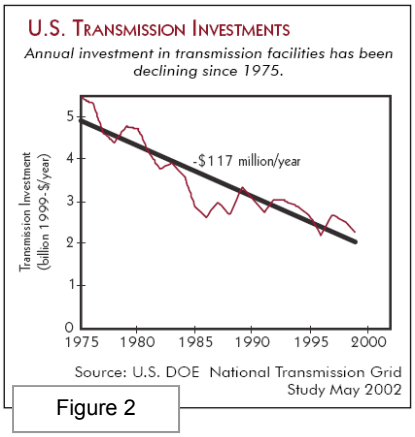


Figure 2

Further exacerbating the problem, the price of electricity rose to $0.21 cents per kilowatt hour in California in 2001 (Figure 3), the state's Public Utilities Commission voted unanimously to reduce that to less than $0.07 cents per kilowatt hour. The state legislature then stepped in to control prices charged consumers throughout California—at rates lower than the utility companies were paying for electricity. It did not take long for the utilities to generate a debt that drove them near and/or into bankruptcy.

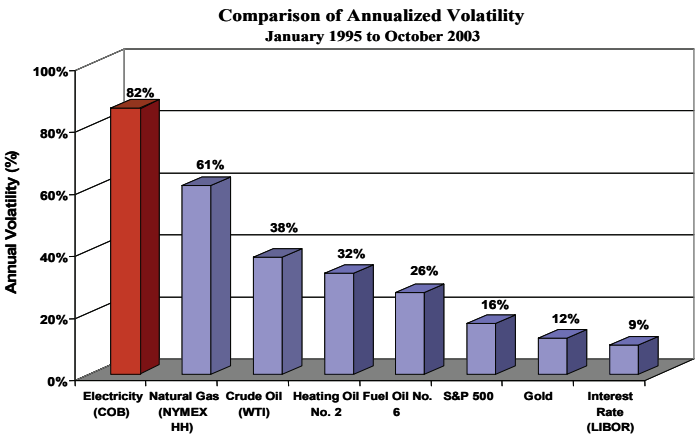


Figure 3 Source: Shell Energy

This convergence of events set the stage for a continuing disaster that would impact utility rates for years to come. The volatility of electricity is one of the greatest variables in the cost of operation. If an organization can tightly control this commodity, it will have a direct impact on the bottom line.

Electricity has proven to be one of the most volatile of the commodities (Figure 3). The energy crisis triggered a $17.4 billion energy bond that will be repaid over the next 20 years by the ratepayers of the investor owned utilities.

2 Problem Statement

Telecommunication cell sites are the central nervous system of the wireless industry. They are vital, expensive and numerous. A vandal who damages one of these sites can cost providers hundreds of thousands of dollars in repairs and lost airtime, not to mention cause a flood of complaints. In other industries, a company's vital, expensive equipment is locked safely in the company's headquarters protected by security guards and surveillance cameras. Wireless-service providers don't have that luxury because their towers, cabinets and monopoles crisscross the country, and many are in remote locations. This may be great for nationwide networking, but it can make security much more difficult. Although site-security problems do not appear to be epidemic, the issue is significant enough that most service providers play their cards close to the vest when discussing security issues.

Competition is fierce in the telecom industry due to technology offerings and price points. Reliability also ranks high with the ever-more discriminating public who expect more from their cell phone. Communications quality and reliability is of utmost concern especially when it comes to customer satisfaction. In the telecom industry if a customer is unable to use their cell phone when they want to make a call, or worse, when they need to make an emergency call, frustration sets in and they start considering their alternatives. Competing cell phone companies are the first reaction for the service challenged customer. Reliability and instant communications is therefore mandatory with any service provider.

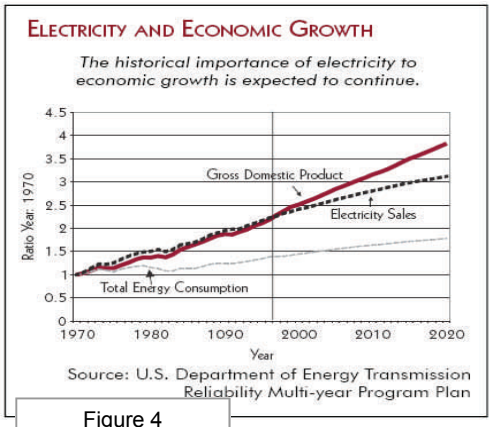


Figure 4

How is a cell phone service provider going to manage their cell sites when the when the local utility is unable to deliver a reliable source of electricity? Certainly there are limitations and hazards to the use of battery backup systems. And too, the ubiquitous diesel generator has many shortfalls given the fuel source along with many environmental considerations. Flywheels are severely limited and have a short ride-through duration. Batteries and flywheels are not designed for any extended operations during a power outage.

There are few alternatives to powering a cell site reliably on a 24/7 basis delivering the quality of power required for the solid state devices. Add to that the ongoing environmental issues of onsite generation using an internal combustion engine even if that was feasible. Environmental regulations often target any device that emits exhaust—even lawnmowers and water heaters.

To further exacerbate the problem we find the current generation, transmission, and distribution system in the US has served the country well in the past, however, the nation's existing electricity grid is in serious need of modernization to serve the 21st Century needs. Realistically, the fundamental architecture of the system is 100 years old, and most of the basic technology is of 1950's vintage. The electricity grid is under great stress and needs to be updated quickly if it is to serve a more demanding and rapidly changing society.

2.1 The Electric Grid & Homeland Security

In Homeland Security Presidential Directive Number 7, President George W. Bush indicated that the energy sector is one of America's critical infrastructures that must be protected from attack. The President directed the Department of Homeland Security to work with the Department of Energy and the private sector to develop protection plans for critical electric, oil and gas infrastructures, which comprise the energy sector.

The expanse of the electric power grid poses enormous challenges to security and energy infrastructure experts wanting to provide protection from physical attacks. It is apparent that total physical protection is not only prohibitively expensive, but probably physically impossible to achieve. Therefore, the focus of electric power infrastructure protection shifts from total physical protection to minimizing the direct and indirect impacts of physical attacks.

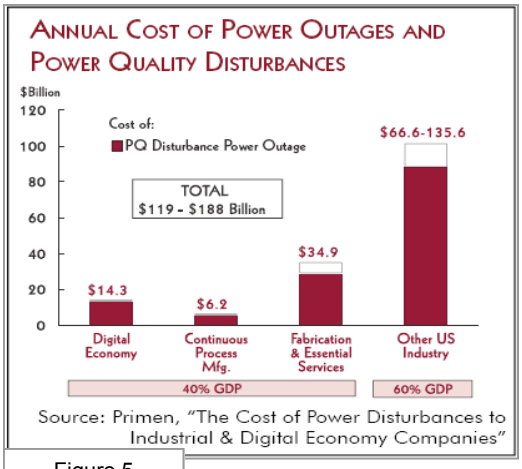


Figure 5

The significance of electricity to the U.S. economy is enormous and the electric grid is an essential part of American life as we know it. In fact electricity has steadily become one of preferred forms of energy. As an example, in 1940 electricity accounted for about 10% of energy consumed, while today it accounts for about 40% of the total consumption. However, for a variety of reasons, there has been a noticeable underinvestment in our electric grid infrastructure. Most of the existing infrastructure of wires, transformers, substations, and switchyards has been in use for 30 years, or more. The aging of this infrastructure, and the increasing requirements placed on it, have contributed to market inefficiencies, electricity congestion, and reduced reliability in many regions of the country. These conditions has lead to higher prices, more outages, decreased power quality, and less efficient use of energy and financial resources. Jobs, environmental protection, public health and safety, and national security are at great risk with the current conditions.

There are many studies outlining the vulnerability of the aging electric grid in the U.S. Only recently has Southern California Edison committed to $10 billion investment over the next five years in improving their electric system. This is a good start for their service territory, which up until now, was somewhat a neglected asset. Additionally, since our country was attacked by terrorists on 9/11, the grid has also become a major target along with most all other critical infrastructure assets. This is the first time in history that this subject has been brought to the surface as an acknowledged Achilles heel of the national energy infrastructure.

According to the President's February 2003 report, The Physical Protection of Critical Infrastructures and Key Assets, there are 13 Critical and Key Assets, there are 13 critical infrastructures and 5 key assets to be secured across the Nation.

Critical Infrastructures

- Agriculture
- Food
- Water
- Public Health
- Emergency Services
- Government
- Defense Industrial Base
- Information and Telecommunications
- Energy
- Transportation
- Banking and Finance
- Chemical Industry and Hazardous Materials
- Postal and Shipping

Key Assets

- National Monuments
- Dams
- Nuclear Power Plants
- Government Facilities
- Commercial key Assets

In a USA Today article by Tim Friend on 6-24-02 titled Power grid vulnerable to attack, report warns "*Extra-high-voltage transformers are cited as particularly vulnerable. The transformers are stocked in limited supply, and replacement can take months or years*."

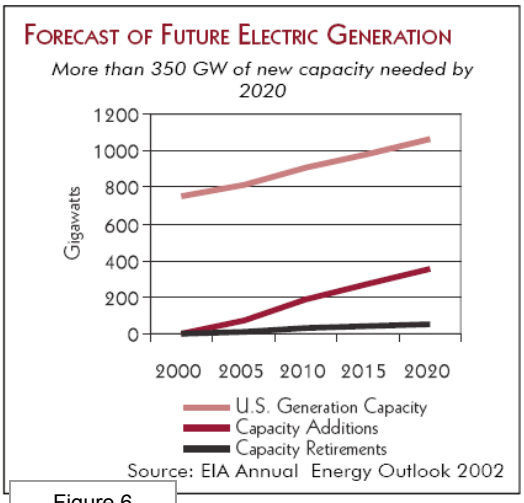
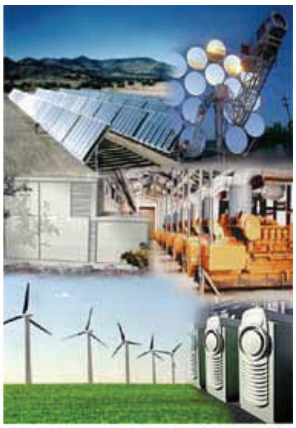


Figure 6

In an article written by Whit Allen, VP Sure Power Corporation titled Power-Grid Independence Means Better Homeland Security 1-14-03, "*DG offers a host of several national security benefits that would otherwise be jeopardized by a reliance on grid-based power*."

Allen summarizes with, "*The conventional electricity grid, in contrast, utilizes hundreds of thousands of miles of power lines and numerous substations - all open to attack at any point. In addition, multiple, small systems are less attractive target for saboteurs seeking to quickly and dramatically disable the nation's day-to-day operations*."

In a panel discussion at a conference on Grid Security, Paul Harmon from RW Beck stated "*As with essentially all infrastructure, electric power systems have vulnerabilities to external forces. Maintaining a completely "secure" transmission system is, therefore, impossible. The nature of the delivery network alone, long stretches of unguarded often remote overhead power lines and switchyards in isolated areas frame just some of the difficulty system owners/operators face in protecting their systems*."



Concerns about national security policies and the need to secure the electric system from threats of terrorism and extreme weather events are affecting the future of America's electric system. A small number of very large generating plants are inherently more vulnerable than a large number of smaller, widely distributed plants. Electric infrastructure, information systems, and cell site owners must harden their facilities to secure their investment and protect their obligation to serve. Techniques and technologies exist for identifying occurrences, restoring systems quickly after disruptions, and providing services during public emergencies.

UC Berkeley Professor Alex Farrell, Energy Resources Group, notes "Grid reliability has always been a concern, adding that historically the greatest stress on our transmission system has been weather. "Now we need to worry about the threat of malicious attacks," he says. DG is more secure because the natural gas distribution network on which most DG systems currently rely is primarily underground, while our high-voltage electric transmission system, which is largely above ground, is more vulnerable." (Farrell, 2004, p. 3) As blackouts rolled across California in 1996, 2000, 2001, coupled with the massive outages that darkened the northeastern U.S. in 2003, it became abundantly clear that, as much as we rely on the utility grid we must take a proactive approach to secure a reliable energy source.

In order to provide the reliability, security, and service that customers need in coming years, we need to fully harden our source of electricity. Every other sector of the nation's economy has made this transition, except for the electricity grid despite the fact that the grid is the most critical part of our entire infrastructure – the life blood of our daily lives. If the electricity grid fails or is taken out in a terrorist attack, for all practical purposes everything else screeches to a halt.

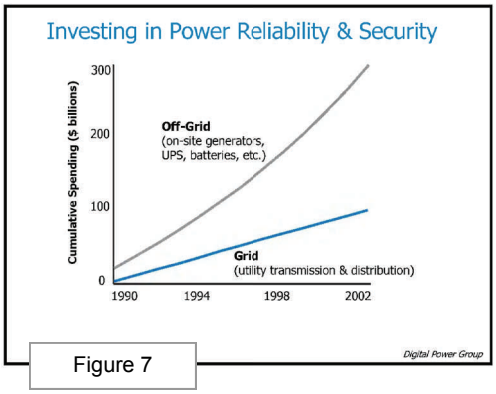


Figure 7

Every day the telecommunications industry must contend with traditional natural and human-based threats to its physical infrastructure, such as weather events, unintentional cable cuts, and the insider threat

The National Strategy for the Physical Protection of Critical Infrastructures and Key Assets

"The terrorist enemy that we face is highly determined, patient, and adaptive. In confronting this threat, protecting our critical infrastructures and key assets represents an enormous challenge. We must remain united in our resolve, tenacious in our approach, and harmonious in our actions to overcome this challenge and secure the foundations of our Nation and way of life."

President George Bush
February 2003

(e.g., physical and cyber sabotage). The September 11 attacks revealed the threat terrorism poses to the telecommunications sector's physical infrastructure. While it was not a direct target of the attacks, the telecommunications sector suffered significant collateral damage. In the future, certain concentrations of key sector assets themselves could become attractive direct targets for terrorists, particularly with the increased use of collocation facilities. The telecommunications infrastructure withstood the September 11 attacks in overall terms and demonstrated remarkable resiliency because damage to telecommunications assets at the attack sites was offset by diverse, redundant, and multifaceted communications capabilities. Figure 7 illustrates the investments in hardening and insulating sites from grid outages.

Priorities for telecommunications carriers are based on service reliability, cost balancing, security, and effective risk management postures. The government places high priority on the consistent application of security across the infrastructure. Although private and public-sector stakeholders share similar objectives, they have different perspectives on what constitutes acceptable risk and how to achieve security and reliability. Therefore, an agreement on a sustainable security threshold and corresponding security requirements remains elusive.

2.2 Distributed Generation

The development of this technology—now called distributed generation, and the regulatory changes needed for its widespread adoption parallels decentralization movements in other network industries, such as telecommunications. Internet technologies and interconnection policies are allowing the migration of network intelligence from a centralized telecommunications core to the end user's phone or computer. Similarly, regulatory changes such as net metering and technologies such as photovoltaics, wind turbines, microturbines, and fuel cells are increasing the migration of centralized electricity generation down to the customers' premises.

Fuel cells have the potential to improve the economic and environmental health of the State of California. They offer substantial benefits including reducing or eliminating air pollutants and greenhouse gas emissions, increasing energy efficiency, promoting energy reliability and security, promoting energy diversity, and helping to realize a sustainable energy future. Fuel cells are particularly well suited for the emerging DG market due to their low acoustic signature, high quality waste heat, potential for high reliability, and low emissions. However, the early market for deployment is challenged by high capital costs of fuel cell product, the undemonstrated durability and reliability of fuel cell technology, and the regulatory and policy hurdles associated with DG. The PEM fuel cell is of particular interest for military applications due to a low thermal signature and noise free operations.

Recent concerns with reliability, the restructuring of the electric power industry, and the energy crisis in California have also contributed to increased interest in DG and its potential to provide opportunities for renewable energy. In its 2003 *Integrated Energy Policy* report, the California Energy Commission (CEC) conducted numerous technical studies, which examined all aspects of energy supply, production, transportation, delivery and distribution, demand and pricing. The report recommends the Governor, Legislature, and other State agencies implement strategies addressing energy-related issues that harvest energy efficient programs, diversify fossil fuels and fuel sources with alternative fuels and renewable energy, offer consumers energy choices, and strengthen the State's energy infrastructure.

According to this report, distributed generation (DG) provides the benefits of improved reliability and power quality, peak-shaving options, security, and efficiency gains through the avoidance of line losses and the use of waste heat for heating and/or air conditioning. Also, in the Energy Action Plan[7] approved by the California Energy Commission, the California Public Utilities Commission and the California Power Authority, it is recommended that the State promote and encourage clean and renewable customer and utility owned DG as a key component of its energy system.

The California Hydrogen Highway Network Blueprint plan, currently under development, identifies hydrogen and the hydrogen-based high-tech emerging industries as holding great promise to address three of California's top priorities: energy security, environmental protection, and economic development. Some technology forecasters believe stationary fuel cells could be the most significant enabling technology in the transition to a hydrogen economy, both from an energy production standpoint and their ability to reduce the cost of developing a hydrogen refueling network. Stationary fuel cells have the potential to become the preferred option for renewable energy supplies.

Base Case for DG Market Potential	Total U.S.
Number of Units	49,500
Capacity (MW)	28,300
Generation (GWh)	204,000
Thermal Output (Billion BTU)	600,000
DG Equipment Sales (Million $)	13,100
Natural Gas Consumption (Billion ft3)	1,360

Table 1 Source: Resource Dynamics Corporation

Most of the literature concludes that a distributed system is one of the most secure methodologies devised. One can equate the Internet and its use of the distributed system as one of reliability. According to the U.S. EPA Combined Heat & Power Partnership, use of generation (CHP) assets located near the point-of-use is the most efficient use of energy resources. Energy security coupled with a keen interest in distributed generation (DG) has increased substantially over the past 10 years because of its potential to provide increased reliability from interrupted service. Combined heat and power delivers lower-cost power and reliability to the DG customer. At no cost to the utility grid, it also adds additional levels of security to the electric grid for other customers.

Since overloading of grids is one of the primary reasons for major blackouts, distributed generation systems improve and help stabilize the grid due to the fact that facilities that use CHP systems generate some or all their power on-site thus reducing the load on the electric power grid. Since CHP systems reduce dependence on large-capacity central generation plants, these systems improve homeland security by reducing the impact if a large central power plant is shutdown for any reason.

In the event of a major gird failure or the loss of a large capacity central generating station, for any reason, including a terrorist attack, CHP systems reduce the impact of such failures because the facilities that use CHP systems can continue to operate to the extent of their on-site generation capacity. For example, during the August 2003 blackout, over 30 hospitals in the region that use CHP systems were able to continue some level of routine operations.

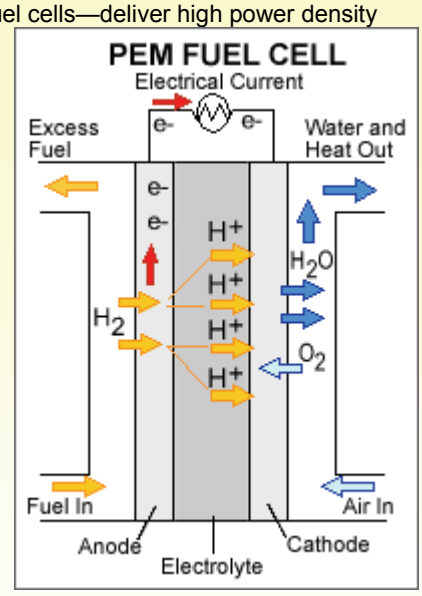
2.3 The DG Market

One of the most secure forms of electricity is that which is generated onsite. A service provider offering products and services to the public can lower costs, improve reliability, reduce emissions, and expand their energy options in a diversified energy portfolio. DG adds redundancy that increases grid security even while powering cell sites and other critical systems.

On a micro level, Southern California Edison (SCE) is aggressively seeking a manufacturer of fuel cells to provide over 200 MW of fuel cells to be delivered starting June 1, 2006 through August 1, 2008, located at strategic sites in the SCE and possibly municipal utility territories.

Polymer Electrolyte Membrane (PEM) Fuel Cells

Polymer electrolyte membrane (PEM) fuel cells—also called proton exchange membrane fuel cells—deliver high power density and offer the advantages of low weight and volume, compared to other fuel cells. PEM fuel cells use a solid polymer as an electrolyte and porous carbon electrodes containing a platinum catalyst. They need only hydrogen, oxygen from the air, and water to operate and do not require corrosive fluids like some fuel cells. They are typically fueled with pure hydrogen supplied from storage tanks or onboard reformers.



Polymer electrolyte membrane fuel cells operate at relatively low temperatures, around 80°C (176°F). Low temperature operation allows them to start quickly (less warm-up time) and results in less wear on system components, resulting in better durability. However, it requires that a noble-metal catalyst (typically platinum) be used to separate the hydrogen's electrons and protons, adding to system cost. The platinum catalyst is also extremely sensitive to CO poisoning, making it necessary to employ an additional reactor to reduce CO in the fuel gas if the hydrogen is derived from an alcohol or hydrocarbon fuel. This also adds cost. Developers are currently exploring platinum/ruthenium catalysts that are more resistant to CO.

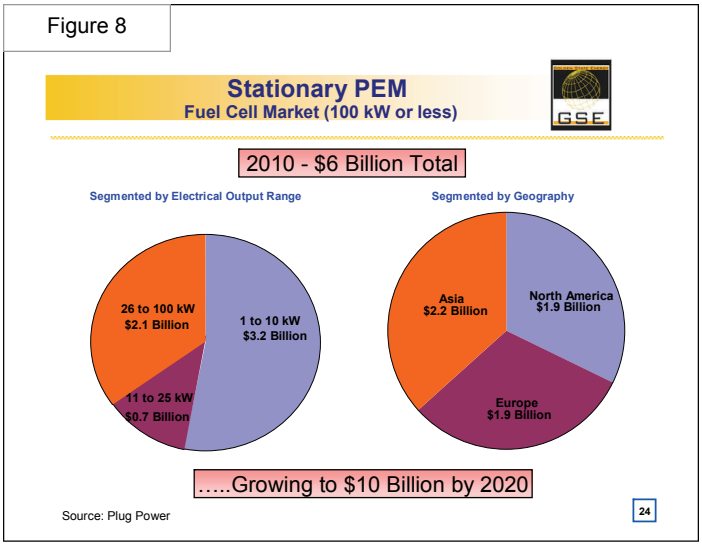
PEM fuel cells are used primarily for transportation applications and some stationary applications. Due to their fast startup time, low sensitivity to orientation, and favorable power-to-weight ratio, PEM fuel cells are particularly suitable for use in passenger vehicles, such as cars and buses.

A significant barrier to using these fuel cells in vehicles is hydrogen storage. Most fuel cell vehicles (FCVs) powered by pure hydrogen must store the hydrogen onboard as a compressed gas in pressurized tanks. Due to the low energy density of hydrogen, it is difficult to store enough hydrogen onboard to allow vehicles to travel the same distance as gasoline-powered vehicles before refueling, typically 300-400 miles. Higher-density liquid fuels such as methanol, ethanol, natural gas, liquefied petroleum gas, and gasoline can be used for fuel, but the vehicles must have an onboard fuel processor to reform the methanol to hydrogen. This increases costs and maintenance requirements. The reformer also releases carbon dioxide (a greenhouse gas), though less than that emitted from current gasoline-powered engines.

Courtesy of Department of Energy

New York (NYSERDA), Long Island Power Authority, and Connecticut have similar programs, and aside from the US market, some countries are mandating the phase-in of fuel cells by certain dates. South Korea is one such country requiring “22% of all power generation and 23% of electricity used by houses be run on fuel cells”. Their Minister of Finance and Economy believes the global business for fuel cells is estimated to be $95 billion by 2010.

Figure 8



3. Transition to a Hydrogen Economy

Hydrogen is colorless, odorless, tasteless, and all around us making up as much as 75 percent of the universe. It is in the water we drink and the food we eat.

Fuel cells are a promising source of clean, reliable, locally-generated energy. The U.S. federal government is providing substantial support to address the challenges confronting the fuel cell industry, including high production costs, the paucity of fuel and repair infrastructures, lingering technological impediments and a low level of public awareness.

In November of 2001 The Department of Energy presented their view of hydrogen in a document titled: A National Vision of America’s Transition to a Hydrogen Economy—to 2030 and Beyond. The meeting was held in response to specific recommendations in the Bush Administration's *National Energy Policy,* which was released on May 17, 2001. This comprehensive energy strategy contains 105 recommendations for securing America's energy future, including the expansion of energy supplies, improvement of infrastructure, modernization of energy conservation, and protection of the environment.

In considering long-term energy and climate change solutions, hydrogen is singled out as a "future energy source...that shows great promise...and is compatible with existing energy technologies, such as fuel cells, engines, and combustion turbines." The report recommends that the U.S. Department of Energy "focus research and development efforts on integrating current programs regarding hydrogen, fuel cells, and distributed energy."

At a broader level, international alliances that seek to accelerate the development and commercialization of fuel cells are taking form. In November 2003, the International Partnership for the Hydrogen Economy (IPHE) was created by the European Commission, the United States, Japan and 13 other countries. In January 2004, the United States and Japan signed a joint statement of intent to pursue pre-competitive research and the development of fuel cell and hydrogen technologies. The European Commission also is expanding its efforts to facilitate Europe's anticipated transition to a hydrogen-based economy.

3.1 Hydrogen; a Renewable Fuel

The composition of landfill gas is typically about 50% methane and 50% carbon dioxide, and less than 1% sulfides (e.g., hydrogen sulfide, dimethyl sulfide, mercaptans) and non-methane organic compounds (NMOCs) (e.g., trichloroethylene, benzene, and vinyl chloride). The amount of sulfides and NMOCs varies from landfill to landfill and depends on whether the landfill receives wastes containing these chemicals and whether chemical reactions are occurring which create or remove them. However, there are other constituents also known as volatile organic compounds which are highly carcinogenic as listed in slide below.

Signed into law on October 22, 2004, H.R. 4520, the “American Jobs Creation Act of 2004,” is a corporate tax measure containing an expanded Section 45 tax credit for LFG electricity-generating facilities. This credit formerly applied to only wind and some biomass energy projects, but Section 710 of the law expands the credit to a wide range of renewables, including landfill gas.

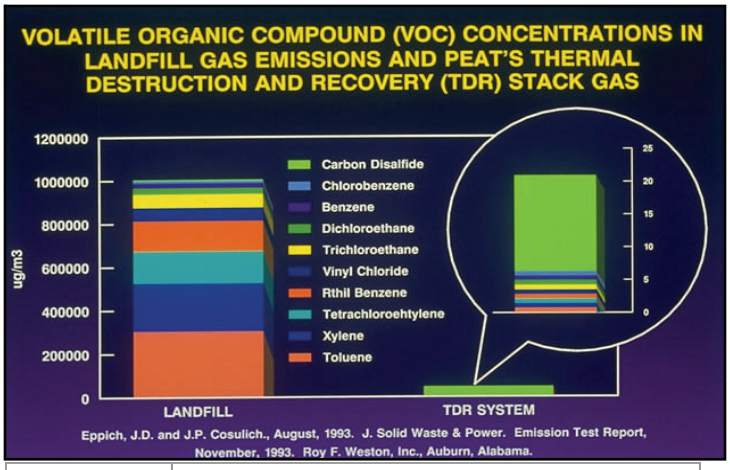


Figure 9	Components of Landfill Gas Emissions VS Plasma Pyrolysis

The expanded Section 45 tax credit is available for electricity produced from open loop biomass (including waste wood and agricultural livestock waste nutrients), landfill gas, trash combustion, geothermal, solar, and small irrigation power facilities that are placed in service prior to January 1, 2006.

The credit is $0.009/kW-hr paid out over a period of five years. As an example of how the credit might be applied, it has been estimated that a typical 3 MW landfill gas (LFG) electricity project with 5% parasitic load and 90% capacity factor would result in just over $1 million in tax credits over the 5 year period, if the project were to come on line in 2005.

Given any site that needs power, if propane can be transported to that location, hydrogen can also be transported. Hydrogen is more portable and less costly than propane. Hydrogen cylinders are bullet-proof and DOT approved. Also, hydrogen is stored above ground in stand-alone racks, which is substantially less costly than burying propane tanks to fuel combustion generators. To collect the incentives, the gas collection and electricity generation systems must be installed and in a condition that is ready to generate electricity prior to January 1, 2006.

"Placed in service" refers to having the electricity generator sets (GENCO) in place prior to the January 1, 2006 deadline. The project does not have to be generating electricity by January 1, 2006 but must be ready to generate electricity. In addition to having the GENCO in place, it is also advisable to have the power purchase and interconnection agreements in place prior to January 1, 2006.

There are a number of ways hydrogen can be produce, as outlined in Figure 15. Between 55%-60% of the hydrogen being produced in the world today is produced by steam reformation. Hydrogen is also produced via water electrolysis using electricity from the grid. Coal and nuclear are possibilities as are solar technologies, including solar photovoltaic, and solar thermal power. Nuclear seems a logical choice since it is a base-loaded technology which allows for production during off-peak hours. Wind is certainly a viable option. Advanced technologies like photochemical, photoelectric chemical, thermal chemical, and thermal chemical—the high temperature processes where solar thermal seems like an ideal resource—which are also under development.

Sources of Hydrogen

Fuel Flexibility means Energy Security. Hydrogen can be produced from a variety of sources:

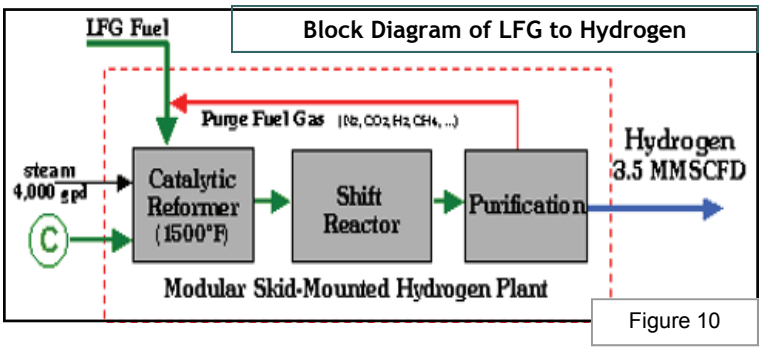
- **Traditional**: natural gas, gasoline, diesel, propane
- **Renewable/alternative fuels**: methanol, ethanol, landfill gas, bio-gas, methane
- **Water**: using electrolysis, solar, or wind power
- **Innovative**: sodium borohydride, algae, peanut shells

Figure 11

Steam methane reformation (SMR) uses a light hydrocarbon feedstock, usually methane, then reacts it with it elevated temperature steam and catalytically converts the feedstock into hydrogen. It operates at around 700°-925° C and can achieve 65%-75% efficiency. Based on an analysis for NASA, the cost for hydrogen from SMR, without adding any environmental cost on polluting fuels, was estimated at $6.00 per gigajoule. Due to rising natural gas costs today, the estimated cost has increased to $10.00 per gigajoule. There are two problems with the SMR process: carbon dioxide (CO_2) production and the volatile cost of the supply of methane or natural gas—unless methane is derived from landfills and biomass. Hydrogen derived from natural gas could be problematic given the demand for natural gas for residential and electric generation draws on reserves. Aside from that, natural gas has a history of price volatility making it an unattractive feedstock.

Thermal Cracking (TDM), on the other hand, produces little CO_2 compared to SMR. For comparison, TDM yields 0.05 moles of CO_2 per mole of H_2 produced and SMR yields 0.43 moles of CO_2 per mole of H_2. In this process, natural gas flame heats up to around 1400° C. The oven is shut off and the natural gas decomposes on the bricks to carbon black and hydrogen at about 800° C. The carbon black is a valuable by-product.

However, there is still an environmental concern since CO_2 is still emitted and we don't know the cost of this process yet. Partial oxidation (POX) uses liquid hydrocarbons that are heavier than naphtha and catalytically converts them to hydrogen.



Block Diagram of LFG to Hydrogen

Figure 10

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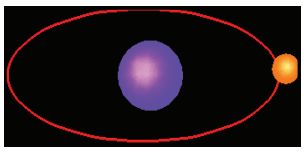


This process achieves about 50% efficiency and operates at temperatures around 1150°-1315° C. The process consists of synthesis gas generation, water-gas shift reaction, and gas purification. Again, CO_2 is an output.

Coal gasification is similar to partial oxidation. However, it can use a wide range of supply fuels like coal, biomass, and residual oils. This type of plant requires pure oxygen and the coal must be pulverized prior to gasification. It can achieve about 48% efficiency and operates at temperatures around 1100°-1300° C.

Biomass hydrogen also is a gasification/pyrolysis process that can be used to generate hydrogen from biomass. The biomass must be prepared by a high temperature and pressure process. This decomposes and partially oxidizes the biomass producing a gas mixture that can be further refined. The entire process is similar to coal gasification but requires the pretreatment step. Since the fuel is biomass, it also has the important advantage of not adding more CO_2 into the atmosphere. Advanced electrolysis technologies work with alkaline water, seawater electrolysis, solid polymer electrolyte, and solid oxide electrolyzer. Seawater is a viable possibility however, maintenance problems with chlorine and corrosion could be a driving factor. Solar-powered electrolysis can be achieved with photovoltaic and solar thermal power. New developments in nano-rectenna conversion (i.e., 3rd Generation PV) and combined power/cooling cycle also are promising. The first two technologies already are available. Costs have come down tremendously over the past two decades and some of the new developments, like nano-rectenna conversion and biological photovoltaics, could reduce future costs by orders of magnitude. Any new hydrogen production technology will be compared against steam methane reformation when it comes to commercial investment.

Plasma pyrolysis is an emerging technology that produces a hydrogen rich gas as a byproduct of processing waste streams. Hazardous waste processed with a plasma energy system can produce more useable energy than that consumed in the electrotechnology process. There are several systems operational on a worldwide basis, some of which are currently being designed to use the hydrogen-rich gas to produce electricity for the process.

The costs hydrogen based on fossil fuels are driving up while the costs based on renewable energy production are going down. In fact, the cost for steam methane reformation has

Hydrogen Production Sources

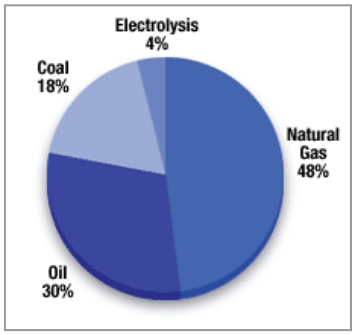


Figure 12

5,000 psi TriShield Quantum Tanks

10,000 psi TUFFSHELL Tanks

300 Standard Cubic Foot Hydrogen Cylinders @ 2,300 PSI

Hydrogen Basics

Fuel cells run on hydrogen, the simplest element and most plentiful gas in the universe. Hydrogen is colorless, odorless and tasteless. Each hydrogen molecule has two atoms of hydrogen, which accounts for the H_2 we often see. Hydrogen is the lightest element, with a density of 0.08988 grams per liter at standard pressure, yet it has the highest energy content per unit weight of all the fuels – 52,000 Btu/lb, or three times the energy of a pound of gasoline.

Hydrogen is never found alone on earth — it is always combined with other elements such as oxygen and carbon. Hydrogen can be extracted from virtually any hydrogen compound and is the ultimate clean energy carrier. It is safe to manufacture. And hydrogen's chemical energy can be harnessed in pollution-free ways.

Hydrogen is the perfect companion to electrons in the clean energy systems of the future. But hydrogen is not perfect – no fuel is.

Safety

- Because of its high energy content, hydrogen must be handled properly, just as gasoline and natural gas today require careful handling. Hydrogen is no more dangerous than other fuels, just different.
- Hydrogen-based fuels like “town gas” were used in many communities in the U.S. and are still used around the world.
- Hydrogen is made, shipped and used safely today in many industries worldwide. Hydrogen producers and users have generated an impeccable safety record over the last half-century.
- Liquid hydrogen trucks have carried on the nation's roadways an average 70 million gallons of liquid hydrogen per year without major incident.

gone up within less than six months. This analysis assumes that new developments in solar thermal power, photovoltaic, and digester gas will reduce their costs, and although not explicitly included, wind would become part of the mix. This analysis does not include any environmental penalty for fossil fuels, although one could argue that there is about $15 per gigajoule ($15/GJ) in environmental costs when using coal as a feed stock, about $13/GJ when you use petroleum as feed stock, and about $9/GJ when you use natural gas as feed stock. Many renewable hydrogen technologies are currently available.

3.2 Benefits of Fuel Cells

There is a little known transition taking place similar to the computer revolution that transformed and created a new industry with the personal computer. The new revolution is taking place in the power generation sector creating a whole new industry with the fuel cell. The fuel cell brings power generation to the end-user creating a network of distributed resources and a more secure power source right down to the homeowner level. As with the personal computer, the fuel cell will become the personal power supply for everyday use.

Security of Supply—Because they are efficient, modular and fuel flexible, fuel cells can enable a transition to a secure, renewable energy future, based on the use of hydrogen.

- A fuel cell system that includes a "fuel reformer" can utilize the hydrogen from any hydrocarbon or alcohol fuel – natural gas, ethanol, methanol, propane, and even gasoline or diesel. Hydrogen can also be produced from electricity from conventional, nuclear or renewable sources.

- Hydrogen can be extracted from novel feedstocks such as landfill gas or anaerobic digester gas from wastewater treatment plants, from biomass technologies, or from hydrogen compounds containing no carbon, such as ammonia or borohydride.

- A process called electrolysis uses an electric current to extract hydrogen from water. Fuel cells, in combination with solar or wind power, or any renewable source of electricity offer the promise of a totally zero-emission energy system that requires no fossil fuel and is not limited by variations in sunlight or wind flow. This hydrogen can supply energy for power needs and for transportation.

Due to the distributed nature of fuel cells, it allows the country to move away from reliance on central station power generation, and long-distance, high voltage power grids, which are the most likely terrorist targets in any attempt to cripple our energy infrastructure.

High Reliability—Fuel cells can be configured to provide backup power to a grid-connected customer, should the grid fail. They can be configured to provide completely grid-independent power. Or they can use the grid as the backup system. Modular installation (the installation of several identical units to provide a desired quantity of electricity) provides extremely high reliability -- in specialized applications, fuel cells can achieve up to 99.9999% reliability, less than one minute of down time in a six year period.

High Quality Power—Fuel cells offer high quality power, crucial to an economy that depends on increasingly sensitive computers, medical equipment and machines.

High Efficiency—Because they make energy electrochemically, and do not burn a fuel, fuel cells are fundamentally more efficient than combustion systems.

Power Generation—Fuel cell power generation systems in operation today achieve 40 percent fuel-to-electricity efficiency utilizing hydrocarbon fuels.

• Systems fueled by hydrogen consistently provide 50 percent efficiency. Even more efficient systems are under development.

Fuel cells are providing a new alternative for reliable backup power generation and energy storage, in response to the growing needs of telecommunication infrastructure, data centers and other mission critical applications. The value proposition behind the use of fuel cell power modules for backup power systems extends well beyond their clean and emission-free features – fuel cells also meet the need for providing an economical solution that has increased flexibility and reliability, as well as the ability to run for extended periods of time.

Fuel cells running on hydrogen provide the benefits of batteries and diesel generators without the associated downsides. Diesel generators have a longer runtime than batteries; however, this is significantly compromised by noise, emissions and the risk of fuel spills. Add to that another element, diesel generators have high maintenance costs incurred by regular servicing to

> **"We are seeing a converging, interdependent "mega-infrastructure" that involves energy, telecommunications, transportation, and electronic commerce. Innovation throughout the electric energy supply chain is essential for this to be fully realized. The resulting benefits will be profound in terms of U.S. productivity, security, and competitiveness."**
>
> **Kurt Yeager, President Emeritus**
> **Electric Power Research Institute**

ensure reliability. Batteries also have drawbacks – they degrade over time, do not operate effectively beyond a limited temperature range, and have high full-life-cycle costs – in part due to hazardous waste disposal costs. In other words, incumbent technologies have worked to a point but they leave quite a bit to be desired. Fuel cells also provide an optimized solution by separating power and energy. As load demand increases, an additional power module can be added in parallel or, if running time requirements increase, additional storage can be supplied. This versatility has been incorporated into Altergy Systems rack-mounted fuel cell modules offering scalable power outputs based on 5-kW, 10-kW, 20-kW, and 30-kW modularity, with the ability to build a power density in a single standard 19" server rack.

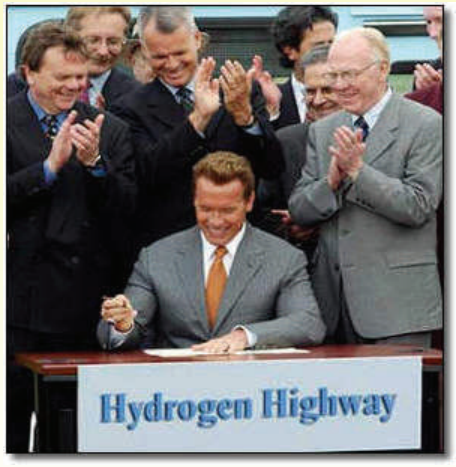
The robust value proposition of the Altergy Systems fuel cell system is that it allows load-shedding and/or be dispatched at-will to the utility grid. Backup power is a logical stepping stone to widespread commercialization of fuel cell systems for the telecommunications industry. Not only is this a quantum leap for the fuel cell technology, it is what commercialization is all about.

Figure 13

3.3 California Hydrogen Highway

California is facing major challenges in the areas of air pollution, public health, energy security, and national security as a result of our over-dependence on petroleum fuels. One in six children in the State's most polluted regions suffer from asthma, and over three-quarters of the State does not meet national primary or secondary ambient air quality standards. In 2003, 60% of the state's air pollution came from mobile sources (cars, trucks, buses and other forms of transportation). The citizens of California have been enduring frequent gasoline price spikes and the State is facing critical shortages in refining capacity, which will drive prices even higher.

A solution to these problems is to begin building a bridge to a cleaner, more secure and more sustainable transportation and energy future. The goal of the California Hydrogen Highway Network initiative is to support and catalyze a rapid transition to a clean, hydrogen transportation economy in California, thereby reducing our dependence on foreign oil, and protecting our citizens from health harms related to vehicle emissions.



"We have an opportunity to deal with these problems by investing in California's ability to innovate our way to a clean hydrogen future, thus bringing jobs, investment, and continued economic prosperity to California"

Governor Schwarzenegger

The "Vision 2010" for California's Hydrogen Highways is to ensure that by the end of the decade every Californian has access to hydrogen fuel along the State's major highways, with a significant and increasing percentage of that hydrogen produced from clean, renewable sources. This vision for California is real and attainable; however, it will take time to implement the hydrogen infrastructure.

To expedite the transition of our transportation system away from petroleum fuels, towards hydrogen fuel and vehicles, experts point to the crucial need for a hydrogen fueling infrastructure and the necessary leadership to make it a reality. An early network of only 150 to 200 hydrogen fueling stations throughout the State (approximately one station every 20 miles on the State's major highways) would make hydrogen fuel available to the vast majority of Californians.

This early vision for California's Hydrogen Highway Network is achievable by 2010 and will help demonstrate the economic and technical viability of hydrogen technologies. Studies by the California Fuel Cell Partnership and others estimate that this initial low-volume fueling network will cost $75 - $200 million, the majority of this investment coming from private investment by energy companies, automakers, high-tech firms, and other companies.

California is already a clear leader in the areas of advanced vehicles, alternative fuels and clean energy. Already there are over a dozen hydrogen fueling facilities in California and more than 40 fuel cell vehicles have been placed in demonstration programs throughout the state. At least nine more hydrogen stations will be added in 2004 (several more are planned but not yet announced).

Hydrogen Production Technologies

- ✓ Biomass Gasification
- ✓ Biological Production
- ✓ Coal Gasification
- ✓ Electrolysis
  - Grid (Coal, Nuclear)
  - Solar Photovoltaic
  - Solar Thermal Power
  - Wind
- ✓ Partial Oxidation
- ✓ Photochemical
- ✓ Photo-electrochemical
- ✓ Steam Reformation
- ✓ Thermal Cracking
- ✓ Thermal Decomposition
- ✓ Thermochemical
  - Solar Thermal
  - Nuclear

In order to achieve the "2010 Vision," the California Hydrogen Highway Network Action Plan is developing public/private partnerships that will work together to invest in the early infrastructure development, and to address key hydrogen commercialization challenges.

The public sector needs to play a role in setting the stage for hydrogen commercialization (incentives, loan guarantees, revenue bond funding, education and training, etc) so that investment by the private sector can take place and the market can develop.

altergy systems

3.4 About Altergy Systems

Altergy Systems® is a privately held fuel cell company, founded in 2001 with the objective of changing the paradigm of the way a fuel cell is built. The management team's strategy of leveraging their fuel cell and manufacturing expertise avoids the massive R&D investment, a common characteristic of the fuel cell sector, while creating a low cost fuel cell solution.

There are two patents issued to Altergy and four patent applications, along with other intellectual property elements held as trade secrets. Five of these patents or applications address key technologies that enables reliability, robustness, manufacturability, and low cost. A second issued US patent addresses an integrated fuel cell power system. Additionally, Altergy has branded its products and secured a registered trademark for Altergy® and Altergy Systems® and pending trademarks for *Freedom Power Systems*™ and *Freedom Power Packs*™.

Altergy Systems recently delivered the very first (and only) hydrogen fuel cell power system ever purchased by the State of California. This system is being used and demonstrated by the State internally and at energy symposiums, trade shows, alternative energy displays, and energy conferences. It powers computers, lights, and appliances showing that a freestanding hydrogen fuel cell system is now both workable and affordable. The Altergy® *Freedom Power System*™ was chosen by the State of California over all other competitors after detailed engineering, manufacturing and fiscal reviews. They believe in the low cost manufacturability of this product.

The California Stationary Fuel Cell Collaborative appointed Altergy to the ten-member board of directors. The board directs the efforts of the Collaborative 150 plus member companies and is instrumental in setting standards, managing regulatory issues and establishing public policy for fuel cells on a nation-wide basis.

4 Incentives to Use Fuel Cells

Economic development is about building local prosperity. Improving productivity is a fundamental driver to prosperity while innovation is a key driver to productivity. With this in mind, many states strive to build an economic base within their boundaries because this economic engine helps boost revenues for the local economy and state coffers. States benefit from a "hot" economy and work very hard to stimulate such activities.

As part of that economic development, each year more than $1.5 billion is made available by utilities, government agencies and other sources to help pay for emerging technologies and energy efficiency. The following sections examine the overall utility and governmental incentives to finance, build, own, and operate fuel cells within the legal boundaries of their governance. It also examines a state-by-state incentive which may include fuel cells directly, or through a renewable fuel incentive. Although some incentives expire from time to time, others emerge providing a robust environment for capital formation and investment.

Many of the incentives are designed to assist building a secure grid without the direct investment in a capital outlay. Figure 16 is indicative of what must be done to attract capital formation to augment the utility investment. Many of the categories may reflect solar (photovoltaic), wind, biomass, and solar-thermal for incentives. Most but not all include fuel cells as part of the incentive offering.

There are many other Federal incentives for renewable energy programs that may include fuel cells and/or clean energy which are not covered by this report. They include but are not limited to:

- U.S. Department of Agriculture
- U.S. Department of Energy
- U.S. Department of Housing and Urban Development
- U.S. Department of Transportation
- U.S. Department of Veterans Affairs
- U.S. Environmental Protection Agency
- U.S. Small Business Administration

"As part of the President's plan to modernize the electric grid (and telecommunications infrastructure), it is critical to demonstrate technologies which add reliability and resiliency to the grid."

Kevin Kolevar
Office of Electricity Reliability and Energy Security

4.1 Net Metering

"Net-metering" is a simplified method of metering the energy consumed and produced at a home or business that has its own renewable energy generator, such as a fuel cell or photovoltaic system. Under the definition of net metering, excess electricity produced by the fuel cell system will spin the existing home or business electricity meter backwards, effectively banking the electricity until it is needed by the customer. This provides the customer with full retail value for all the electricity produced. The standard kilowatt-hour meter used for most residential and small commercial customers accurately registers the flow of electricity in either direction. This means the 'netting' process associated with net metering happens automatically — the meter spins forward (in the normal direction) when the customer needs more electricity than is being produced, and spins backward when the customer is producing more electricity than is needed in the home or building. The meter registers the net amount of energy produced or consumed during the billing period.

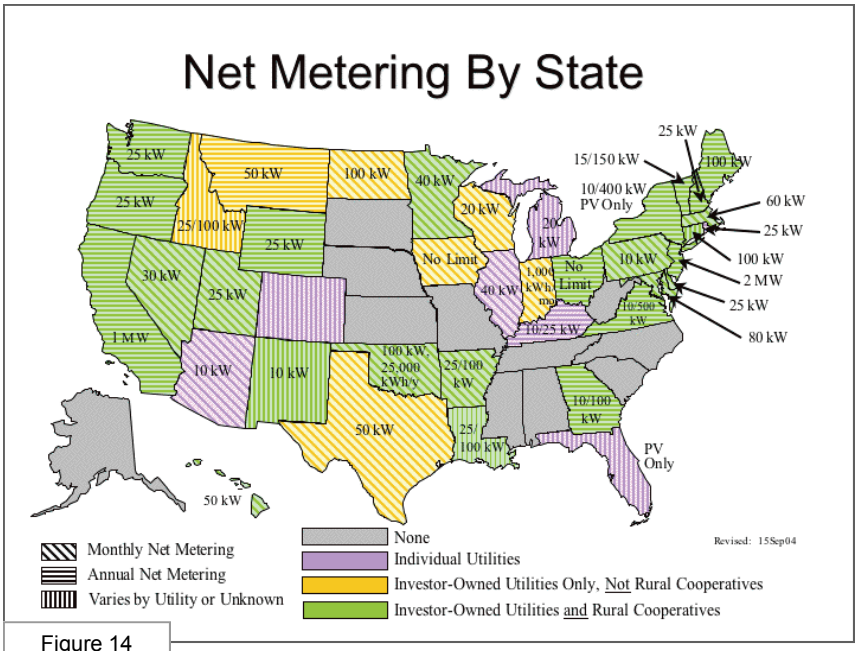


Figure 14

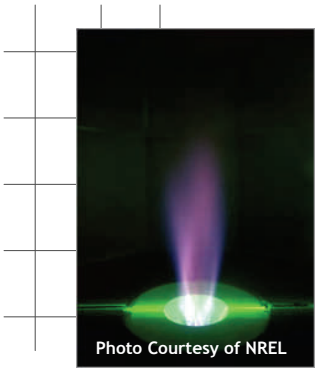


Photo Courtesy of NREL

"The market for automotive power and stationary generation conversion equipment is the largest market for capital equipment in the world. Fuel cells and fuel cell powered vehicles will be an economic growth leader in the coming decades securing high quality employment for many thousands of people."

Source: Fuel Cell World

Under existing federal law (PURPA, Section 210) utility customers can use the electricity they generate with a fuel cell to supply their own lights and appliances, offsetting electricity they would otherwise have to purchase from the utility at the retail price. But if the customer produces any excess electricity (beyond what is needed to meet the customer's own needs) and net metering is not allowed, the utility purchases that excess electricity at the wholesale or 'avoided cost' price, which is much lower than the retail price.

The excess energy is metered using an additional meter that must be installed at the customer's expense. Net metering simplifies this arrangement by allowing the customer to use any excess electricity to offset electricity used at other times during the billing period. In other words, the customer is billed only for the net energy consumed during the billing period.

Net metering, a crucial regulatory policy and financial incentive to encourage the adoption of renewable, distributed energy technologies, exists at various levels in 38 states. Net metering allows generators to receive full retail credit for excess electricity produced by eligible facilities.

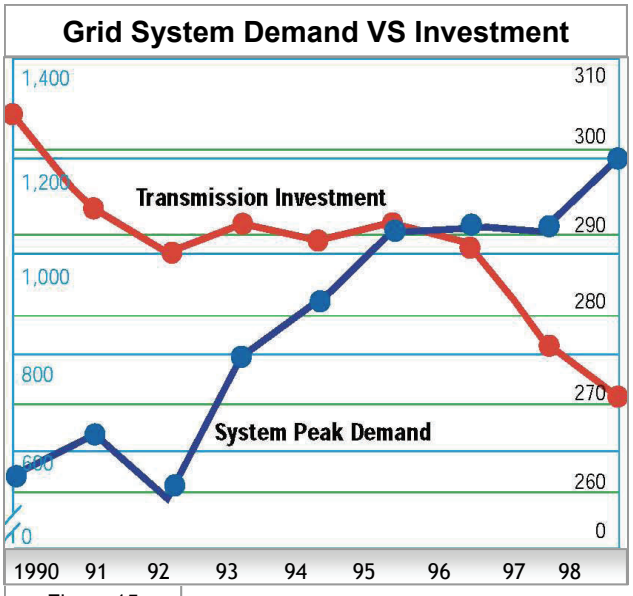


Figure 15

Thirteen states and the District of Columbia have statewide net metering policies that apply to all utilities and include fuel cells as an eligible technology: Arkansas, Connecticut, Georgia, Idaho, Louisiana,* Massachusetts, New Mexico, Ohio, Oregon, Rhode Island, Utah, Vermont and Washington. Net metering policies and conditions vary widely, although all 14 of these statewide policies include residential fuel cell applications. Most of these policies are also available to the commercial and industrial sectors. Moreover, Idaho, Louisiana and Vermont imbed agricultural facilities in these policies.

Common Misconceptions About Net Metering

1. If my generating system produces more electricity than I need, my electric service provider must buy it from me.
Wrong: ESPs may, but are not required to, purchase any excess electricity you produce at the end of each year of your net metering agreement. State law specifically states that your ESP does not have to buy your net generation. However, some ESP, especially those specializing in selling "green" electricity, may be willing to buy your excess solar or wind electricity for resale to their other customers.

2. My electric service provider will pay me full retail rates for my excess electricity.
Wrong: If they are willing to buy this "net" annual generation, they do not have to pay you full retail prices for it. While the actual rate paid would be up to the ESP, it would likely be less than retail and closer to "wholesale" rates, which are much lower.

3. I will have to spend hundreds of dollars on special meters, inspections or fees to get my system hooked up to the electric grid.
Wrong: You are only responsible for having a simple, bi-directional meter, the type you probably already have. If your generating system meets national safety and performance standards, you cannot be charged for additional tests, certification or fees.

4. The kilowatt-hours of electricity I might still need to buy from an ESP will cost me more than before I became a net metered customer.
Wrong: Your ESP cannot charge you anything extra for being a net metered customer and no charges can be imposed on the electricity you generate.

ESP vs. LDC

Most electricity customers are not aware that, as a result of the recent deregulation of utilities here in California, their old electric utility no longer exists. It has now been replaced by two companies to bring them electricity, an "electric service provider" or "ESP" and a "local distribution company" or "LDC." This change is similar to the deregulation of telephone services twenty years ago. That deregulation meant that the company that sells you long distance telephone service may now be a different company from the company that maintains and owns the telephone wires into your home. This is now the same case for electricity, where the company that supplies the electricity that you purchase, your "ESP," may be a different company than the one that owns and maintains the power lines to your house, which is your "LDC." Your old utility company is most likely still your LDC and may also be your ESP, unless you have chosen to buy your electricity from one of the many new electric service providers that have been formed to market electricity. With net metering, the metering arrangement is with your ESP, while the details of how your generating system must be safely connected to the electrical grid is handled by your LDC.

4.2 Overview of State Policies

Federal funding for fuel cells largely supports research and development efforts for both stationary and automotive fuel cell applications, as well hydrogen infrastructure issues. State-level funding, on the other hand, tends to support the adoption of stationary fuel cells by end-users. A thorough knowledge and understanding of available state-level incentives may prove beneficial to those with an interest in the development and deployment of stationary fuel cells. Furthermore, stakeholders should be aware that there is a "long-standing tradition in American governance whereby states serve as laboratories for subsequent federal policy." In California, this is especially true through several mechanisms created to foster the development of emerging technologies.

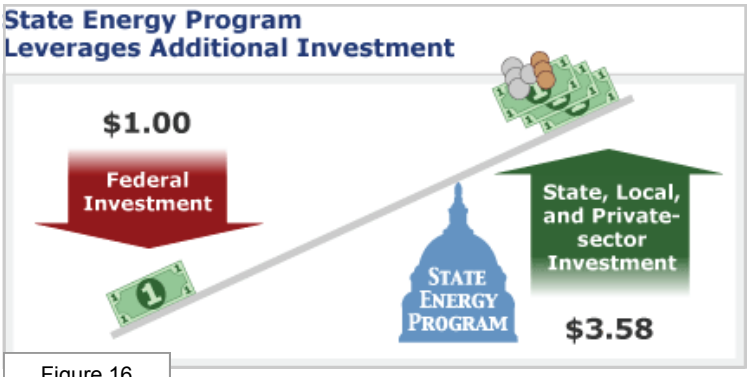
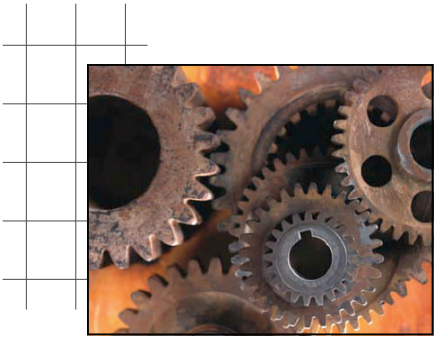


Figure 16

DOE's State Energy Program leverages $3.58 in additional investment in energy projects from other federal programs, state and local governments, and private companies for every dollar of federal investment from SEP.

It is important to recognize that most state-level financial incentive programs for which stationary fuel cells are eligible were not designed exclusively to support fuel cells. Rather, these programs typically are designed to promote the development and adoption of multiple renewable energy technologies. Many of these incentive programs also support wind, photovoltaics (PV), biomass, small-scale hydro, and/or other renewable energy systems. Blending of technologies may benefit a project beyond the original incentive of installing the technology.

For the latest incentives at all levels:
http://www.dsireusa.org/



However, 10 new incentive programs were created during 2003 and 2004:

- **Massachusetts** - Fuel Cell Grants
- **New Jersey** - Renewable Energy Advanced Power Program (a grant program)
- **New Jersey** - Renewable Energy Economic Development (REED) Program (a grant program)
- **New Jersey** - Reduced Energy Demand Options (REDO) for Local Governments and Schools (a loan program)
- **New Mexico** - Clean Energy Grants Program
- **Pennsylvania** - Energy Harvest Grant Program
- **New York** - Solar and Fuel Cell Electric Generating Equipment Tax Credit
- **Louisiana** - Net Metering policy
- **Maine** - Renewable Resources Matching Fund Program (a grant program)
- **Wyoming** - Renewable Energy Tax Exemption

The net gain of state-level incentive programs is encouraging, especially considering the current dreary condition of dozens of state budgets. Stakeholders should be aware that a February 2004 report issued by the National Conference of State Legislatures warned that 31 states will have budget gaps totaling $35.6 billion for fiscal year 2005.

Another significant development in 2003 was the creation and evolution of the Public Fuel Cell Alliance (PFCA), a coalition of state, federal and international stationary fuel cell programs collaborating "to accelerate the widespread adoption and commercialization of stationary fuel cell technologies, fuel cell deployment and hydrogen infrastructure development in North America." The PFCA, which was still in the development process at the time of this writing, is supported by agencies in 21 states.* Among other intentions, the PFCA proposes to facilitate joint projects among partners and serve as an information clearinghouse that will collect, standardize and publicize information pertaining to state, federal, and other fuel cell incentives and programs.

The PFCA may be organized as a project of the Clean Energy States Alliance (CESA), a new non-profit organization comprised of 17 state energy funds from 12 states.* The CESA, managed by the Clean Energy Group, was established in January 2004.

For more information:
http://www.cleanenergystates.org/JointProjects/fuelcells.html

* The PFCA is supported by Alaska, California, Connecticut, Delaware, Florida, Hawaii, Illinois, Indiana, Massachusetts, Michigan, Minnesota, Mississippi, New Jersey, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, and Texas.

NOTE: The CESA is supported by California, Connecticut, Illinois, Massachusetts, Minnesota, New Jersey, New York, Ohio, Ore-

4.2A Renewable Energy Credits

Buying green power can help stimulate the market for renewable energy. The concept is simple enough: apply a monetary value to the collective environmental and societal benefits from the electrical power generated at renewable energy facilities, and sell them.

Renewable Energy Credits (RECs) are playing an increasingly important role in financing renewable projects. **RECs-Based Financing** is a fundamental of structuring REC-based projects.

The definition of a Renewable Energy Credit or REC, is that it represents one megawatt hour (MWh) of renewable energy that is physically metered and verified from the generator, or the renewable energy project. REC's are created when a renewable energy project is certified and begins producing renewable energy. Renewable energy projects create green power which helps reduce pollution. Renewable Energy Credits are the group of environmental benefits society benefits from in the production of green power. The green-power (electricity) is sold into the local electric grid where the renewable energy project is located. The REC's are sold separately as a commodity into the marketplace.

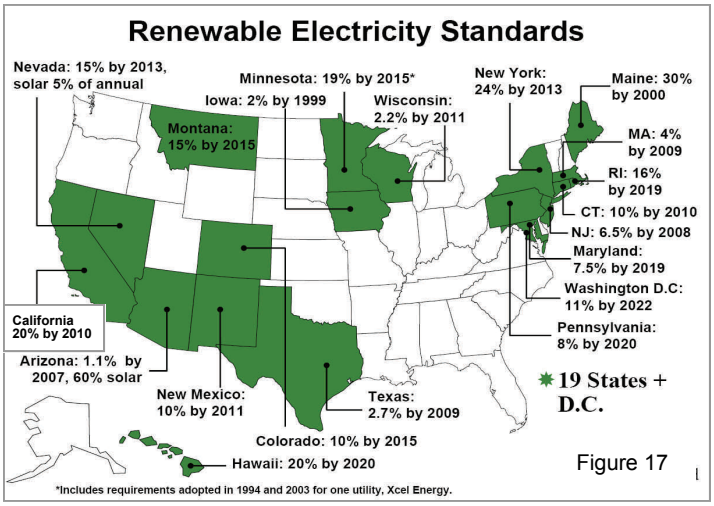


Figure 17

It is estimated that REC's are a green force that will create a $3.0 trillion commodity market over the next 20 years. This may sound optimistic, however, past market values were valued from $0.50 per ton to $17 per ton of displaced carbon dioxide. Demand is growing, and values are rising given the support of several states (see Figure 20) leading the nation.

Connecticut's legislature strengthened the state's Renewable Portfolio Standard (RPS). As a result, offer prices for Connecticut RPS—eligible RECs skyrocketed from $1 per megawatt-hour to $40 per megawatt-hour. Connecticut belongs to the New England Power Pool (NEPOOL), along with Massachusetts, Maine, New Hampshire, Rhode Island, and Vermont. The New RPS requires Connecticut power producers to purchase and retire a higher quality of NEPOOL certificates from eligible resources such as wind, methane, fuel cells, solar photovoltaics, and some hydropower and biomass.

"I believe that one day hydrogen and oxygen, of which water is constituted, will…..represent an inexhaustible source of warmth and light."

Jules Verne
Mysterious Island (1874)

Top 5 Energy Distribution Companies Most Impacted by State Renewable Portfolio Standards

Company	State	Percent of Total State Retail Sales	Investment Necessary to Meet Standards in 2020
SCE	CA	22.1%	$3.6 Billion
ComEd (Exelon)	IL	50.5%	$3.5 Billion
PG&E	CA	20.3%	$3.3 Billion
PECO (Exelon)	PA	23.8%	$1.9 Billion
PPL	PA	23.8%	$1.9 Billion

Table 2

Source: Global Energy Decisions, 2005

State Renewable Portfolio Standards (RPS) are reaching critical mass creating the most important development in US renewable energy of the last 25 years. According to Renewable Energy: The Bottom Line measured the economic, technology and policy implications of renewable energy and state mandated RPS.

- State RPS drives the need for 52,000 MW of new renewable energy projects in the next 15 years.
- The 52,000 MW gap to meet the RPS will require $53.4 billion in new investment to build renewable projects.
- The top 25 affected utility companies will account for nearly 63% of the cumulative investment needed to meet the standards by 2020 will be responsible for 76% of RPS.

> "In a REC deal, the power from the new renewable energy facility is not physically delivered to the customer, but the environmental benefits created by the facility are attributed to that customer, directly offsetting the environmental impact of the customer's conventional energy use."
>
> **Bonneville Environmental Foundation**

4.3 Industry Recruitment Incentives and Corporate Tax Credits

Five states—California, Hawaii, Michigan, Montana, and Ohio—offer generous corporate tax credits or exemptions in an effort to recruit fuel cell manufacturers. Michigan and Ohio are the most aggressive states in this category. Under the NextEnergy economic development plan, Michigan offers multiple tax benefits to companies engaged in the research, development, or production of fuel cells. Eligible companies receive a full property tax exemption on alternative energy equipment, a full exemption from the state's personal and real property tax, an exemption from the state's education tax, and a personal income tax credit equal to the sum of the state income taxes paid by company employees.

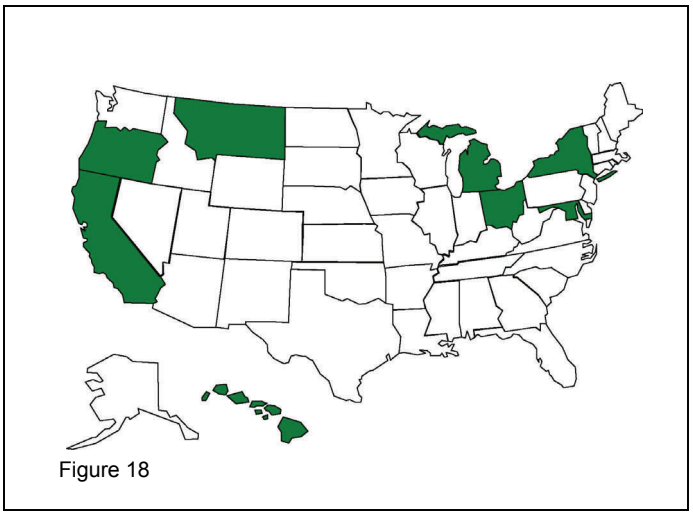


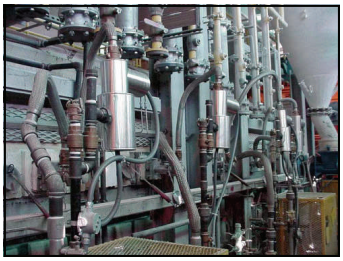
Figure 18

States With Industrial Recruitment Incentives or Corporate Tax Credits for Stationary Fuel Cell Deployment.

Ohio's three-year, $103 million fuel cell initiative, which took effect in May 2002, includes $75 million to fund a direct loan program specifically for fuel cell businesses locating or expanding in the state.

Hawaii offers a 100 percent tax credit on equity investments in businesses primarily engaged in manufacturing high technologies, including fuel cells. In Montana, commercial investments in alternative energy systems—including fuel cells—totaling or exceeding $5,000 are eligible for a tax credit of up to 35 percent on income generated by these investments. Associated facilities, including manufacturers of alternative energy equipment and industries using the energy generated, are also eligible for this credit. In addition, Oregon offers a 35 percent credit on the incremental cost of fuel cell installations in commercial or industrial facilities.

Maryland and New York offer corporate tax credits for the inclusion of fuel cells in the construction of green buildings. In Maryland, qualifying green buildings that incorporate fuel cells receive a tax credit equal to 30 percent of a fuel cell's installed cost. In addition, New York offers a credit equal to 30 percent of the capitalized cost of a fuel cell used in green building construction.



"Hydrogen can be produced from domestic sources—initially natural gas; eventually clean coal….That's important. If you can produce something yourself, it means you're less dependant upon somebody else to produce it."

President George W. Bush
February 6, 2003

4.4 Grant Programs

Of the 10 new incentives created by states in 2003 and early 2004, six of these were grant programs. A new Massachusetts grant program covers up to 25 percent of the total capital costs for the purchase and installation of fuel cells. A maximum award of $2,000,000 is available to businesses, nonprofits, and state and local government agencies under this program, which is supported by the state's public benefits fund.

In addition, Massachusetts' Green Buildings Initiative provides awards of up to $500,000 to encourage the incorporation of fuel cells and other renewable energy technologies into new building construction.

New Jersey's Renewable Energy Advanced Power Program, created in 2003, encourages the development of distributive renewable electricity generation projects, including fuel cells. Awards cover up to 20 percent of total construction and other qualifying costs in non-residential facilities. This program is funded by the state's societal benefits charge. Another new program created by New Jersey in 2003, the Renewable Energy Economic Development (REED) Program, provides funding in the form of a recoverable grant for the development of renewable energy businesses, renewable technologies and market infrastructure. Businesses and nonprofit organizations are eligible for grants of up to $500,000 under the REED program.

Illinois Clean Energy Community Foundation provides funding for renewable energy for projects demonstrating the market viability of solar thermal, biomass, fuel cells, or other emerging renewable distributed power generation technologies.

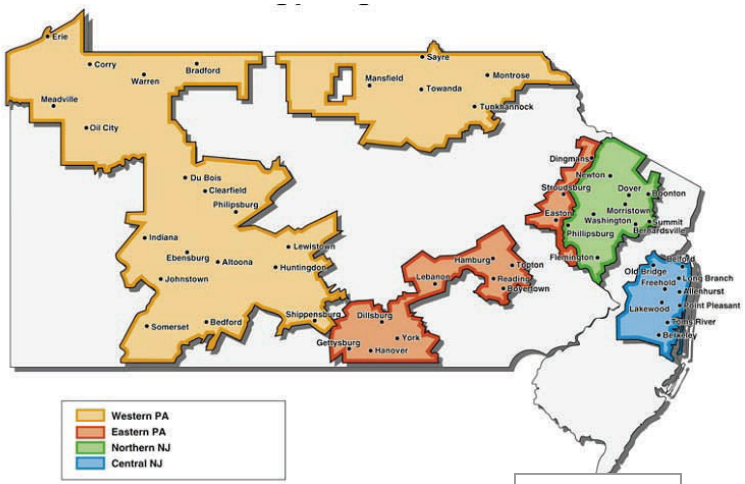


Figure 19

Metropolitan Edison Company Sustainable Energy Fund Region

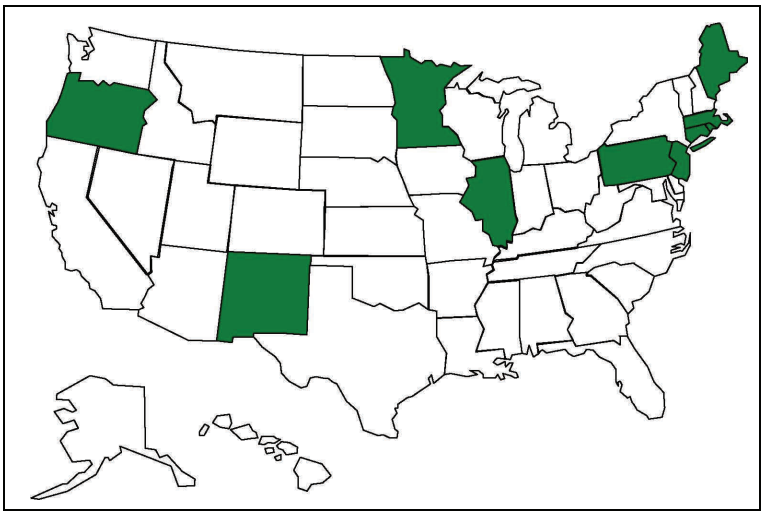


Figure 20

States Offering Grants Supporting Stationary Fuel Cell Deployment.

New Mexico's new Clean Energy Grants Program, created in March 2004, provides funding for renewable energy projects, including fuel cells. Grants are available to state and local government agencies, schools and tribal governments. (The legislation that created New Mexico's Clean Energy Grants Program also established a statewide hydrogen and fuel cell technologies development program, which includes an outreach and education component.)

* Louisiana's net metering vaguely-worded net metering legislation, enacted in June 2003, allows commercial, industrial, residential and agricultural facilities to net meter electricity generated by fuel cells. At the time of this writing, the Louisiana Public Service Commission was still developing guidelines for Louisiana's net metering policy and interconnection standards.

* This map does not include several states that operate grant programs specifically supporting research and development efforts for renewable energy technologies, including fuel cells.

First Energy established the Metropolitan Edison Company Sustainable Energy Fund within Berks County Community Foundation in 2000 with an initial contribution of $5.7 million. The purpose of the fund is to promote:

- Development and use of renewable energy and clean energy technologies
- Energy Conservation and Efficiency
- Sustainable energy business
- Project that improve the environment in the companies service territories, as defined by their relationship to the companies transmission & distribution facilities

For more information: http://www.sustainableenergyfund.org/

Pennsylvania's Energy Harvest Grant Program, created in 2003, provides grants to encourage businesses, nonprofits, schools, agricultural facilities and local government agencies to improve air quality, preserve land and protect local watersheds while providing economic opportunities for the state's agricultural community. There is no maximum award for this program, for which fuel cell projects are eligible. Total funding for the Energy Harvest Grant Program is $5 million. Other grant opportunities exist in Pennsylvania through the state's four major distribution utilities; these programs were created in cooperation with the state government following Pennsylvania's restructuring process.

Illinois offers two grant programs for which fuel cells are eligible. The Illinois Renewable Energy Resources Program, which is supported by the state's public benefits fund, was restructured in 2003 and now involves an annual solicitation process. One of two solicitations issued by this program in 2003 offered grants of up to $225,000 for fuel cell projects. In addition, the Illinois Clean Energy Community Foundation (ICECF) offers grants for which fuel cells are sometimes eligible. ICECF solicitations are issued twice per year and vary.

Oregon's New Renewable Energy Resources Grants fund a variety of projects in residential, commercial, nonprofit, school and local government facilities. This program, which awards approximately $1.5 million annually, is supported by the state's public benefits fund. Maine's Renewable Resources Matching Fund Program, created in 2003, offers matching grants to nonprofit organizations for community-oriented demonstration projects using renewable energy technologies. This program, supported by Maine's public benefits fund, provides a maximum award is $50,000.

In January 2003, Connecticut issued a solicitation for the installation and demonstration of fuel cells at businesses, schools, nonprofit organizations or local government agencies. A total of $4 million was made available under this solicitation, which specifically targets fuel cells. In December 2003, Minnesota issued solicitations for renewable energy projects totaling $25 million. Fuel cells projects are eligible under some Minnesota solicitations, which are funded by the state's public benefits fund. In 2003, Rhode Island issued a solicitation intended to encourage large-scale energy consumers to purchase electricity generated by renewable resources. This solicitation offered a total of $500,000 to support proposals by large-scale consumers and utilities for the purchase or sale of green power to large-scale consumers in Rhode Island. These awards are supported by the state's public benefits fund.

Block Allocated Capacity	Incentive Block* 1 (6.23 MW)	2 (5.5 MW)	3 (12.5 MW)	4 (27 MW)
Tier 1 (up to 10 kW)	$5.00/watt	$5.00/watt	$4.00/watt	$3.00/watt
Tier II (from 10 to 100 kW)	$4.00/watt	$4.00/watt	$3.00/watt	$2.00/watt
Tier III (from 100 to 500 kW)	$3.00/watt	$3.00/watt	$2.00/watt	$1.50/watt
Tier IV (over 500 kW, up to 1000 kW)	$0.30/watt	$0.30/watt	$0.20/watt	$0.15/watt
Maximum incentive as percentage of eligible system costs	60%	50%	40%	30%

* Note: Incentive levels will change over time as capacity allocated for each block is filled.

At least 50% of the Capacity in blocks 2, 3, and 4 is reserved for small systems (10 kW or less)

Table 3 New Jersey Incentives

Several additional state-level grant programs exist, but these are not incorporated into various maps and state tallies present in this report due to their peripheral nature. Michigan offers grants for energy efficiency projects, potentially including fuel cells with heat recovery applications, with funding from the state's public benefits fund. Michigan's grant awards vary by solicitation. Furthermore, several states—including California, Connecticut, Indiana, Massachusetts, Minnesota, New York, Ohio and Texas—operate grant programs that support research and development efforts for renewable energy technologies, including fuel cells. Of these states, Connecticut and Ohio have programs specific to fuel cells.

4.5 Rebate Programs

Although only two states offer rebate programs for fuel cells, these incentives are among the most generous of all state-level incentives. California's Self-Generation (SELFGEN) Program pays large-scale generators the lesser of $4.50 per watt or 50 percent of the cost of grid-tied fuel cells using a renewable fuel, and the lesser of $2.50 per watt or 40% of the cost of grid-tied fuel cells using non-renewable fuels and incorporating heat recovery technologies. Fuel cells with a capacity of 30 kilowatts to one megawatt are eligible for this rebate program.

California's Emerging Renewables Program offers rebates for the purchase and installation of fuel cells with a maximum capacity of 30 kilowatts. This program—available to the businesses, residents and agricultural facilities—makes awards to eligible applicants based on system capacity. The Emerging Renewables Program, which is funded by California's public benefits fund, was restructured over the past year. Rebate amounts have decreased recently due to California's budget crisis, but is currently $3.20/watt.

New Jersey's Clean Energy Program, funded by the state's societal benefits charge, provides enticing rebates of up to $5 per watt for fuel cells, depending on capacity. This incentive is available to businesses and residents.

* Although the maximum system size eligible for California's SELF-GEN Program is 1.5 megawatts, incentive payments do not extend beyond one megawatt.

More Information About the California Emerging Renewables Program

(Formerly the Emerging Renewables Buydown Program)

In February 2003, this program was renamed the **Emerging Renewables Program**. An additional $118,125,000 was allocated for Emerging Renewables Program rebates. Amount levels may vary depending on system size, technology and type of installation through a multi-year rebate program of payments to buyers, sellers, lessors or lessees of eligible electricity generating systems powered by emerging renewable energy resources. The technologies eligible to participate in the Emerging Renewables Program are photovoltaic (PV) systems, solar thermal electric systems, fuel cell technologies that utilize renewable fuels, and small wind systems.

For information about applying for the Emerging Renewables Program's rebates and for documents and guidelines, please visit the Consumer Energy Center: www.ConsumerEnergyCenter.org/erprebate/

The initial allocation was for $54 million under the California Energy Commission's **Emerging Renewable Resources Account**, the former name of this program. This was for the four-year period following the March 1998 start of the first part of this program. At least 60 percent of the $54 million in program monies (and 60 percent of the funds in each initial block of funds) must be awarded to systems of 10 kilowatts (kW) or smaller in rated output. An additional 15 percent of the program funds in each block were reserved for systems rated at 10 to 100 kW or less.

Payments from the Emerging Renewables Program are intended to reduce the net cost of generating equipment using emerging renewable technologies and thereby stimulate substantial sales of such systems. Increased sales of generating equipment are expected to encourage manufacturers, sellers, and installers to expand their operations and reduce their costs.

Along with expanding the sales of emerging renewable technology systems, another goal of the Emerging Renewables Program is to encourage the siting of small, reliable distributed generating systems throughout California in locations where the produced electricity is both needed and consumed. To be eligible for the Emerging Renewables Program rebate, these generating systems must be located on the premises of customers of California's investor-owned electrical utilities (PG&E, SCE and SDG&E) and sized so that the electricity they produce offsets part or all of the electrical needs of the premises.

Although the Emerging Renewables Program is open to emerging renewable generating systems of all sizes, subject to certain conditions and restrictions, it was designed to favor small generating systems, such as those typically used by residential or small commercial and agricultural customers. These conditions and restrictions are outlined in **Emerging Renewables Program Guidebook.**

Applicants for funding from the Emerging Renewables Program must submit a reservation request that describes the system they are purchasing. The system must be on a list of certified equipment established by the Energy Commission. Once a reservation is accepted, applicants of 10kW or smaller systems have up to nine months to complete their systems. Applicants of larger projects have up to 18 months to install their systems. Only upon proof of installation, along with an appropriate five-year warrantee on the system, will the Energy Commission provide the buydown funding for the system based upon the system characteristics as installed. These program requirements encourage applications to the program that reflect quality equipment and serious intent to purchase and install the equipment.

For additional information regarding the Renewable Energy Program areas, please contact:

Renewable Energy Call Center
Toll Free - (800) 555-7794
Outside California - (916) 654-4058
E-mail: renewable@energy.state.ca.us

4.6 Loan Programs

Five states operate loan programs for which fuel cells are eligible. The California Consumer Power and Conservation Financing Authority offers low-interest loans ranging from $2 million to $10 million per applicant (with maximum awards of $40 million per company) for the purchase and installation of renewable energy systems. Loans may also be used by manufacturers of renewable energy systems or components that establish or expand facilities in California. (This program is also listed as an industrial recruitment incentive in Section 4.3)

Ohio's Renewable Energy Financial Assistance Program offers low-interest loans of up to $50,000 to residents and $500,000 to businesses for the implementation of energy efficiency or renewable energy projects. This program is funded by the state's public benefits fund. (Ohio's fuel cell loan program is listed as an industrial recruitment incentive in Section 4.3.)

Ohio Governor Bob Taft recently announced a 3 year extension of the Ohio Fuel Cell Initiative at the 2005 Ohio Fuel Cell Coalition (OFCC) symposium. This extension comes on the heels of two new Fuel Cell Initiative awards, worth a total of more than $2.0 million. Created in 2002, the Ohio Fuel Cell Initiative is a $103 million program that aims to position Ohio as a national leader in the growing fuel cell industry and help stimulate economic growth and job creation in the state. To date, more than $38 million in Fuel Cell Initiative funds have been awarded to projects across the state.

The Initiative is an integral part of Governor Taft's Third Frontier Project, a $1.1 billion program designed to create jobs and bring new products to market. This group recently approved $1.6 million in operating funds for the Wright Fuel Cell Group, Ohio's Wright Center of Innovation for fuel cells led by Chase Western Reserve University.

Montana's Alternative Energy Revolving Loan Program provides loans to residents and small businesses to purchase renewable energy technologies, including fuel cells. New Jersey implemented a new loan program in early 2004, offering low-interest loans to schools and local government agencies to cover the incremental cost of energy efficiency and renewable energy projects. Pennsylvania does not offer a statewide loan program, but the state's four major distribution utilities offer separate loan programs for which fuel cells are eligible. These programs were created in cooperation with the state government following Pennsylvania's restructuring process.

Although Indiana and Mississippi offer low-interest loan programs for which fuel cells are potentially eligible, it is unlikely fuel cell projects will be chosen in the near future, according to the program managers. (Furthermore, Mississippi's program was suspended in early 2004.)

4.7 Production Incentives

Production incentives can have a major impact on emerging renewable energy technologies. The federal Renewable Energy Production Incentive (REPI)—which, at the time of this writing, was suspended for new projects as of December 31, 2003—has been crucial to the development of the U.S. wind industry. This incentive is directed at utilities and also applies to electricity generated by fuel cells.

Over the past two years, Rhode Island's State Energy Office has issued solicitations geared toward commercial generators and utilities to encourage the generation of electricity by renewable energy systems, including fuel cells. This production incentive, funded by Rhode Island's public benefits fund, has paid up to $0.03 per kilowatt-hour for electricity produced during a five-year period.

4.8 Personal Tax Credits

Four states offer personal tax credits as a means of enticing residents to purchase stationary fuel cells. In 2003, New York implemented a tax credit of 20 percent for fuel cells installed a taxpayer's principal residence, with a maximum credit of $1,500. Maryland's personal tax credit is essentially identical to its corporate tax credit; both provide a credit of 30 percent for fuel cells used in new green buildings. Residents of Oregon and Montana are eligible for tax credits of up to $1,500 and $500, respectively, for the purchase and installation of fuel cells.

4.9 Tax Exemptions

Four states have implemented a sales tax exemption or reduction for the purchase of stationary fuel cells, and several others offer other tax exemptions. Maryland offers a full sales tax exemption specifically for fuel cells. Nevada exempts fuel cells from local sales tax. Vermont exempts fuel cells of 15 kilowatts or less from the state sales tax, and Washington exempts fuel cells of at least 200 watts from the state sales tax.

Residents and businesses in Oregon are exempt from paying property tax on the added value to a property resulting from the installation of fuel cells and certain other renewable energy technologies. Montana offers a property tax exemption on the assessed value of fuel cells used in buildings. Also, renewable energy systems in Montana with a minimum capacity of one megawatt are eligible for a 50 percent reduction of the state's corporate property tax for five years, and a diminished reduction for the subsequent five years. Furthermore, renewable energy systems with a capacity of less than one megawatt are exempt from property taxes for five years after start of operation.

In 2003, Wyoming enacted legislation exempting the sale of certain renewable energy equipment, including fuel cells, from the state excise tax. (Michigan's tax exemptions, which are classified as industrial recruitment incentives in this report, were discussed in Section 4.3.)

4.9A Other State-Level Policies

Some states have adopted comprehensive regulatory policies to ensure the creation of an in-state renewable energy industry. Public Benefits Funds (PBFs) and Renewable Portfolio Standards (RPSs) are two such policies.

Most existing PBFs—also known as system benefits charges (SBCs)—were created by states as part of the electricity market restructuring process. PBFs are typically supported by a small surcharge on all electric bills. These funds vary widely in size and scope, and generally finance energy efficiency improvements, renewable energy projects, and low-income housing projects and improvements.

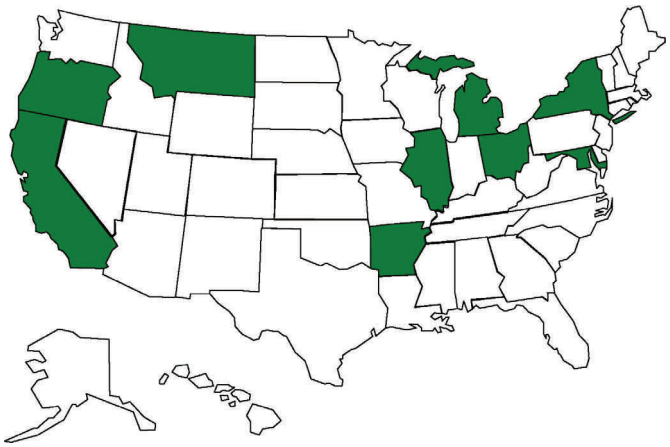


Figure 21 *States With Public Benefit Funds Supporting the Deployment of Stationary Fuel Cells.*

Fifteen states currently have PBFs that support renewable energy projects, and 12 of these support fuel cells: California, Connecticut, Illinois, Maine, Massachusetts, Minnesota, New Jersey, New York, Ohio, Oregon, Pennsylvania and Rhode Island. Several of the more generous fuel cell incentive programs already discussed in this report are financed by PBFs, including California's Emerging Renewables Program, Massachusetts' fuel cell grant program, Minnesota's grant program, New Jersey's Clean Energy Rebate Program, New Jersey's Renewable Energy Advanced Power Program, Ohio's Renewable Energy Loan program and Rhode Island's production incentive.

Thirteen states have imposed a renewable portfolio standard (RPS) on large-scale electricity generators, requiring these generators to use specified renewable energy resources to supply a certain percentage of their electricity by a specified year. Like PBFs, these policies have a tremendous potential to create a renewable energy industry within state boundaries. These standards also vary greatly among states, particularly in terms of eligible renewable energy resources, the percentage of renewable energy required from these resources, and mandated deadline. Fuel cells are an eligible technology to achieve standards in eight states: California, Connecticut, Hawaii, Maine, Massachusetts, New Jersey, New Mexico and Wisconsin.

Furthermore, at least five states fund and actively participate in organizations that engage in statewide outreach and/or public education programs promoting the deployment of fuel cells. These organizations include the California Fuel Cell Partnership, the California Stationary Fuel Cell Collaborative, NextEnergy (Michigan), a recently established hydrogen and fuel cell technologies development program in New Mexico, the Ohio Fuel Cell Coalition, and the Infinite Power of Texas.

Massachusetts Hydrogen Coalition Unveils Hydrogen and Fuel Cell Initiatives to Capture Future $46 Billion Industry—The Massachusetts Hydrogen Coalition, Inc. has unveiled initiatives to propel Massachusetts to the vanguard of the future $46 billion hydrogen and fuel cell industry. A report published by PricewaterhouseCoopers forecast that "Global demand for fuel cells is projected to be nearly $46 billion in 2011", creating a significant opportunity for jobs and the economy of Massachusetts. With the highest density of hydrogen and fuel cell organizations of any state in the country, with more than 80 active organizations, Massachusetts is well positioned to capture this tremendous growth opportunity.

On March 27, 2001, the California Public Utilities Commission (CPUC) announced new incentive programs to encourage residential and commercial electricity customers to install grid-tied renewables and clean distributed-generation (DG) systems. The Self-Generation Incentive Program (SGIP) offers incentives to encourage customers to produce electricity with microturbines, small gas turbines, wind turbines, photovoltaics (PV), fuel cells and internal combustion engines. The incentive payments range from $1/W - $4.50/W, depending on the type of system, and will be funded through the end of 2007. AB 1685 of 2003 provided funding of approximately $500 million and extended the program expiration date from December 31, 2004 to January 1, 2008. The bill also expanded some program requirements, as well as the definitions of "ultra clean" and "low-emission" DG.

On December 16, 2004, the CPUC approved a decision adopting a number of important modifications to the SGIP. The decision includes the following provisions:

1. A new incentive structure and payment amounts eliminated the percentage of project-cost cap (effective for all projects not already holding an approved conditional reservation on the date of the decision).

2. The SGIP rebate will be considered the "last rebate" applied in cases where other incentives will be obtained. Projects receiving incentives based on future performance of the system are not eligible to receive a SGIP rebate.

3. The maximum eligible system size was increased to 5 MW, although the incentive payment remains capped at 1 MW.

4. The annual maximum Corporate/Government Parent limit per service territory was increased from 1 MW to 4 MW. (This provision is subject to clarification by the CPUC).

5. Recommendations for an exit strategy and a declining rebate schedule recommendation will be developed with public input.

6. The SGIP procedures and rules handbook will be modified to (a) address the certification of projects to meet new emission standards required by AB 1685, (b) eliminate the requirement that proponents of projects reapply for incentives in the subsequent funding cycle, and (c) include procedural or financial mechanisms to deter inappropriate reservation requests.

The December 2004 CPUC decision is not clear concerning the new incentive amounts granted for several technology categories. The SGIP Working Group has requested clarification from the CPUC. In the meantime, the following technologies and corresponding incentive amounts apply:

- PV (Level 1) - $3.50/W
- Fuel cells using renewable fuels (Level 1) - $4.50/W
- Fuel cells using non-renewable fuels (Level 2) - $2.50/W

PG&E, SCE, and SoCal Gas will administer the incentive program in their service territories, and the San Diego Regional Energy Office will administer the program in SDG&E's territory. Customers of PG&E, SDG&E, SCE and SoCal Gas should contact their program administrator for an application, program handbook and additional eligibility information.

Program Administrator Contact Information:

Pacific Gas & Electric (PG&E)
Web: www.pge.com/selfgen
Phone: 415-973-6436
Email: selfgen@pge.com
Fax: (415) 973-2510
Mailing Address: Self-Generation Incentive Program
P.O. Box 770000
Mail Code B27P
San Francisco, CA 94177-001

San Diego Regional Energy Office (administrator for San Diego Gas & Electric, or SDG&E)
Web: www.sdenergy.org
Contact: Nathalie Osborn, Program Manager
Phone: (858) 244-1193
Phone 1-866-SDENERGY
Fax: (858) 244-1178
Email: selfgen@sdenergy.org
Address: San Diego Regional Energy Office
Attn: SELFGEN Program Manager
8520 Tech Way Suite 110
San Diego, CA 92123

Southern California Edison (SCE)
Web: www.sce.com/sgip
Phone: 1-800-736-4777 or (626) 302-8436
Fax: (626) 302-6253
Email: greenh@sce.com
Address: Program Manager Self-Generation Incentive Program
Southern California Edison
2131 Walnut Grove Avenue, 3rd Floor, B 10
Rosemead, California 91770

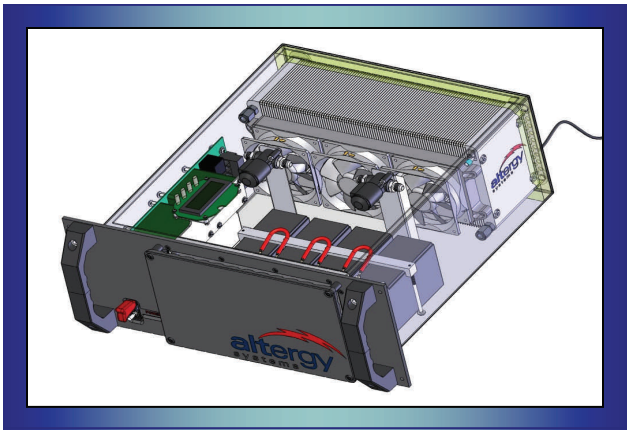
Southern California Gas Company (SoCalGas)
Web: www.socalgas.com/business/selfgen
Phone: 1-866-347-3228
Email: selfgeneration@socalgas.com
Fax: (213) 244-8222
Address: Self-Generation Incentive Program Administrator
Southern California Gas Company
555 West Fifth Street, GT22H4
Los Angeles, CA 90013-1011

Contact:

Valerie Beck
California Public Utilities Commission
Energy Division
State Building
350 McAllister Street
San Francisco, CA 94102
Phone: (415) 703-2125
E-Mail: vjb@cpuc.ca.gov
Web site: http://www.cpuc.ca.gov

The Massachusetts Hydrogen Coalition is proposing seven initiatives to significantly expand the hydrogen and fuel cell industry in Massachusetts. These initiatives include developing the Massachusetts Clean Energy Corridor, establishing a hydrogen and fuel cell center, establishing a clean energy export program, greater education and outreach, increased state resource allocation and procurement, and establishing appropriate tax and financial incentives. As a first step, the coalition will work collaboratively with representatives from state agencies, institutions, universities and industry leaders to develop the Massachusetts Hydrogen Roadmap.

* Maine's public benefits fund is supported by voluntary contributions. Michigan has a public benefits fund that supports energy efficiency projects. Although fuel cell projects with heat recovery applications are potentially eligible for funding in Michigan, solicitations vary. Hawaii has a renewable portfolio *goal;* there are no penalties for non-compliance.



4.9B Federal Incentives—Renewables

There are many areas where the Federal Government plays an important role in developing renewable energy. This section will review the current incentives. The Energy Policy Act of 2005 was approved and signed by the President, there may be other incentives adding value to many fuel cell related activities.

The following relevant areas of interest will be reviewed:

1.) Corporate Exemption—Residential Energy Conservation Subsidy Exclusion (Corporate)

2.) Corporate Tax Credit—Renewable Electricity Production Tax Credit, and, Solar and Geothermal Business Energy Tax Credit

3.) Federal Grant Program—Renewable Energy Systems and Energy Efficiency Improvements Program, and, Tribal Energy Program Grant, and, Value-Added Producer Grant Program

4.) Federal Loan Program—Energy Efficient Mortgage (EEM), and, Energy Star Financing and Mortgages, and, Tax-Exempt Financing for Green Buildings, Renewable Energy & Brownfield Redevelopment

5.) Personal Exemptions—Residential Energy Conservation Subsidy Exclusion (Personal)

6.) Production Incentive—Conservation Security Program (CSP) Production Incentive, and, Renewable Energy Production Incentive (REPI)

Conservation Security Program (CSP) Production Incentive—The U.S. Department of Agriculture announced in March 2005 a nationwide sign-up for the Conservation Security Program (CSP), which will be available to approximately 235,000 farmers and ranchers in 220 watersheds. The CSP is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation. Congress has funded the fiscal year 2005 CSP budget at $202 million.

The 2005 CSP sign-up includes a renewable-energy component. Eligible producers will receive $2.50 per 100 kWh of electricity generated by new wind, solar, geothermal and methane-to-energy systems. Payments of up to $45,000 per year will be made using three tiers of conservation contracts, with a maximum payment period of 10 years.

The 2005 CSP sign-up will be open from March 28, 2005, to May 27, 2005, in selected eight-digit watersheds in all 50 states and the Caribbean. Producers who have a current CSP contract are not eligible for this sign-up. To apply for CSP, potential participants are encouraged to complete a self-assessment workbook to determine if their operations meet the requirements of the program and qualify for program participation.

Additional information on CSP, including eligible watersheds and the self-assessment workbook, is available at: www.nrcs.usda.gov/programs/csp

Contact:

Craig Derickson
U.S. Department of Agriculture
Natural Resources Conservation Service
P.O. Box 2890
Washington, DC 20013
Phone: (202) 720-3524
E-Mail: craig.derickson@np.nrcs.usda.gov
Web site: http://www.nrcs.usda.gov

Residential Energy Conservation Subsidy Exclusion (Corporate Exemption)—According to Section 136 of the IRS Code, energy conservation subsidies provided by public utilities, either directly or indirectly, are nontaxable: "Gross income shall not include the value of any subsidy provided (directly or indirectly) by a public utility to a customer for the purchase or installation of any energy conservation measure."

Energy conservation measure includes installations or modifications that are primarily designed to reduce consumption of electricity or natural gas, or improve the management of energy demand. Dwelling unit includes a house, apartment, condominium, mobile home, boat, or similar property. If a building or structure contains both dwelling and other units, any subsidy must be properly allocated.

Given the definition of "energy conservation measure" there is a strong evidence that utility rebates for residential solar thermal and solar electric projects may be nontaxable. However, the IRS has not ruled definitively on this issue. For taxpayers considering using this provision for renewable energy systems, consultation with tax attorney is advised. Other types of utility subsidies that may come in the form of credits or reduced rates are also nontaxable, as IRS Publication 525 states.

If you are a customer of an electric utility company and participate in the utility's energy conservation program, the customer may receive on the monthly electric bill either:

- a reduction in the purchase price of electricity furnished (rate reduction), or
- a nonrefundable credit against the purchase price of the electricity. The amount of the rate reduction or nonrefundable credit is not included in the income.

Contact:

Information Specialist—IRS
Internal Revenue Service
111 Constitution Avenue, N.W.
Washington, DC 20224

Renewable Electricity Production Tax Credit (Corporate Tax Credit)—The Renewable Electricity Production Credit (REPC) is a per kilowatt-hour tax credit for electricity generated by qualified energy resources. Enacted as part of the Energy Policy Act of 1992, the credit (which had expired at the end of 2001) was extended in March 2002 as part of H.R. 3090, the Job Creation and Worker Assistance Act of 2002. The tax credit then expired at the end of 2003 and was not renewed until October 4, 2004, as part of H.R. 1308, the Working Families Tax Relief Act of 2004, which extended the credit through December 31, 2005.

Section 710 of the "American Jobs Creation Act of 2004" (HR 4520), signed into law on October 22, 2004, expanded REPC to include additional eligible resources. This credit, which formerly applied only to wind energy, closed-loop biomass, and poultry-waste energy projects, now applies to the following:

- Wind
- Closed-loop Biomass
- Open-loop Biomass
- Geothermal Energy
- Solar Energy
- Small Irrigation Power (150 kW — 5 MW)
- Municipal Solid Waste

The REPC provides a tax credit of 1.5 cents/kWh, adjusted annually for inflation, for wind, solar, closed-loop biomass and geothermal. The adjusted credit amount for projects in 2005 is 1.9 cents/kWh. Electricity from open-loop biomass, small irrigation hydroelectric, and municipal solid waste resources will receive half that rate -- currently 0.9 cents/kWh. The duration of the credit for closed-loop biomass and wind continues to be 10 years, while open-loop biomass, solar, geothermal, small irrigation hydro and municipal solid waste resources are eligible for the credit for a five-year period. Refined-coal facilities will receive $4.375 per ton (indexed for inflation) for a 10-year term.

The credit applies to facilities placed in service after October 22, 2004, for most of the newly eligible technologies and before January 1, 2006, with the exception of refined-coal production facilities, which must be placed into service before January 1, 2009. The credit for wind, closed-loop biomass and poultry waste is retroactive to January 1, 2004, as a result of the Working Families Tax Relief Act of 2004. Note, however, that owners of solar and geothermal projects who claim the 10% Federal Business Energy Tax Credit may *not* also claim this production tax credit.

A business can take the credit by completing Form 8835, "Renewable Electricity Production Credit," and Form 3800, "General Business Credit."

Contact:

Information Specialist—IRS
Internal Revenue Service
111 Constitution Avenue, N.W.
Washington, DC 20224
Phone: (800) 829-1040
Web site: http://www.irs.gov

Solar and Geothermal Business Energy Tax Credit— The U.S. federal government offers a 10% tax credit to businesses that invest in or purchase solar or geothermal energy property in the United States. The tax credit is limited to $25,000 per year, plus 25% of the total tax remaining after the credit is taken. Remaining credit may be carried back to the three preceding years and then carried forward for 15 years. Taxpayers can not claim both this business energy tax credit and the credit allowed under 26 USC § 45 (Renewable Energy Production Tax Credit for the taxable year or any prior taxable year.

Solar energy property includes equipment that uses solar energy to generate electricity, to heat or cool (or provide hot water for use in) a structure, or to provide solar process heat. Geothermal energy property includes equipment used to produce, distribute, or use energy derived from a geothermal deposit. For electricity produced by geothermal power, equipment qualifies only up to, but not including, the electrical transmission stage. Energy property does not include public utility property, passive solar systems, pool heating, or equipment used to generate steam for industrial or commercial processes.

To qualify, the original use of the equipment must begin with the taxpayer or it must be constructed by the taxpayer. The equipment must also meet any performance and quality standards in effect at the time the equipment is acquired. The energy property must be operational in the year in which the credit is first taken.

If the project is financed in whole or in part by subsidized energy financing or by tax-exempt private activity bonds, the basis on which the credit is calculated must be reduced. (The formula is described in the tax credit instructions.) Subsidized energy financing means "financing provided under a federal, state, or local program, a principal purpose of which is to provide subsidized financing for projects designed to conserve or produce energy."

The credit is claimed by using IRS Form 3468.

Contact:

Information Specialist—IRS
Internal Revenue Service
111 Constitution Avenue, N.W.
Washington, DC 20224
Phone: (800) 829-1040
Web site: http://www.irs.gov

Renewable Energy Systems and Energy Efficiency Improvement Program (Federal Grant Program)— Section 9006 of the 2002 Farm Bill requires the U.S. Department of Agriculture (USDA) to create a program to make direct loans, loan guarantees, and grants to agricultural producers and rural small businesses to purchase renewable-energy systems and make energy-efficiency improvements. This program is known as the Renewable Energy Systems and Energy Efficiency Improvements Program.

The USDA has implemented this program through a Notice of Funds Availability (NOFA) for each of the last three years. The latest round of funding, totaling $22.8 million, was made available in March 2005. Half ($11.4 million) of this sum is available immediately for competitive grants. Renewable-energy grants range from $2,500 to $500,000 and may not exceed 25% of an eligible project's cost. Applications must be submitted to the appropriate Rural Development State Office postmarked no later than June 27, 2005. Detailed information about the application process and program requirements is available in the March 28, 2005 edition of the *Federal Register*. The remaining half ($11.4 million) will be set aside through August 31, 2005, for guaranteed loans for renewable-energy and energy-efficiency projects. Details on how to apply for guaranteed loans will be published in the *Federal Register* later this year. Any funds not obligated under the guarantee loan program by August 31, 2005, will be reallocated to the competitive grant program as of that date.

The USDA is now in the process of developing regulations for this program, after having issued a proposed rule on October 5, 2004, and receiving comments filed by December 15, 2004. The USDA anticipates publishing the proposed regulation later this year.

Under the proposed rule, eligible renewable-energy projects include wind, solar, biomass and geothermal; and hydrogen derived from biomass or water using wind, solar or geothermal energy sources. The maximum *grant* award is 25% of eligible project costs up to $500,000 for renewable energy projects and $250,000 for energy efficiency improvements. Assistance to one individual or entity is not to exceed $750,000. The minimum grant request is $2,500.

Under the *guaranteed loan* option, funds up to 50% of eligible project costs (with a maximum project cost of $10 million) will be made available. The minimum amount of a guaranteed loan made to a borrower is $2,500. A combined grant and guaranteed loan under this program cannot exceed 50% of eligible project costs, and the applicant or borrower is responsible for having other funding sources for the remaining funds.

The USDA will determine each year if *direct loan* funds are available. If funds are available, a NOFA appears in the *Federal Register*.

For further details, visit the program web site http://www.rurdev.usda.gov/rd/farmbill/9006resources.html or contact your state's Rural Energy Coordinator.

Tribal Energy Program Grant—DOE's Office of Energy Efficiency and Renewable Energy's Tribal Energy Program provides financial and technical assistance to tribes for feasibility studies and shares the cost of implementing sustainable renewable energy installations on tribal lands. This program seeks to promote tribal energy self-sufficiency and fosters employment and economic development on Americas' tribal lands.

Tribal Energy Program funding is awarded through a competitive process. Each solicitation will include instructions on how to apply, application content, and the criteria by which applications will be selected for funding. Consult the program Web site at http//www/eere.energy.gov/tribalenergy/financial.htm for current funding opportunities and past solicitations.

The program is managed by EERE's Weatherization and Intergovernmental Program, implemented by the DOE Golden Field Office, and technical support is provided by Sandia national Laboratories and the National Renewable Energy Laboratory.

Contact:

Thomas Sacco
U.S. Department of Energy
Weatherization & Intergovernmental Program
Forrestal Building, MS 5G-045
100 Independence Avenue SW
Washington, DC 20585
Phone: (202) 586-0759
E-mail: Thomas.sacco@ee.doe.gov
Website: http://www.eere.energy.gov/wip/program/tribalenergy.html

Value-Added Producer Grant Program—A total of $14.3 million in grants was allocated for fiscal year 2005 from the U.S. Department of Agriculture (USDA) to support the development of value-added agriculture business ventures. Value-Added Producer Grants are available to independent producers, agricultural producer groups, farmer or rancher cooperatives, and majority-controlled producer-based business ventures seeking funding for one of the following activities.

(1) planning activities needed to establish a viable value-added marketing opportunity for an agricultural product (e.g. conduct a feasibility study, develop a business plan, develop a marketing plan); or

(2) acquiring working capital to operate a value-added business venture that will allow producers to better compete in domestic and international markets.

Grant awards for fiscal year 2005 supported energy generated on-farm through the use of agricultural commodities, wind power, water power or solar power. The maximum award per grant was $100,000 for planning grants and $150,000 for working capital grants.

Matching funds of at least 50% were required. Applications were due on or before May 6, and the anticipated award date is September 30, 2005. Information about grant recipients and projects from previous years' solicitations is available on the program Web site http://www.rurdev.usda.gov/rbs/coops/vadq.htm .

Application guides and materials for the Value-Added Producer Grant are available at www.rurdev.usda.gov/rbs/coops/vadg.htm. USDA Coordinators for each state are available to assist with questions related to the application process and forms, and other issues.

Contact:

RBS National Office
Department of Agriculture (USDA)
Mail Stop 3250
1400 Independence SW 1400 Independence Avenue, SW
Washington, DC 20250
Phone: (202) 720-7558
E-mail: gpgrants@usda.gov

DoD FY04 Climate Change Fuel Cell Program—The amount of money available for awards is approximately $1,200,000. The amount of any individual DoD Climate Change Fuel Cell Program grant will not exceed the lower of $1,000/kW of installed fuel cell capacity, or one-third of the total project cost, which includes unit cost, installation, and one year of operation.

The new DoD Climate Change Fuel Cell Rebate Program solicitation period is open. This year only $1,200,000 is available; so only unique and outstanding applications will receive rebates. As mentioned, the rebates are $1,100 per kW of installed capacity, but partial grants may be awarded this year due to the limited funding.

4.9C Energy Policy Act of 2005

On August 8, 2005, President Bush signed into law the Energy Policy Act of 2005. Among its provisions — a 30% tax credit up to $1100 per kilowatt on the purchase cost of fuel cells used in residential or commercial applications. Combined with state-level incentives, and the firms successful internal cost reduction efforts, the Altergy Systems fuel cell is expected to more than competitive with current technologies used as primary/backup applications.

The bill also provides a production tax credit of $0.015 per kWh that would be available for fuel cell power plants operating on biomass renewable fuels such as digester gas from digesters and wastewater treatment plants.

Other provisions in the Bill includes:

- $2.0 billion in authorized spending over the next five years for research and development for hydrogen supply and fuel cell accounts program within the DOE;
- $1.3 billion in authorized spending over five years for hydrogen and fuel cell demonstration projects that includes vehicles, stationary, and portable applications;
- $450 million in market transition programs for stationary, portable and micro-fuel cells as well as hydrogen energy systems;
- Credit for business installation of qualified fuel cells, stationary microturbine power plants, and solar: The provision provides a 30% business energy credit for the purchase of qualified fuel cell power plants for businesses. Credits apply to periods after December 31, 2005 and prior to January 1, 2008

President Bush Signing Energy Bill
August 8, 2005

Courtesy of White House

The purpose is to stimulate market acceptance; support development of technology and require federal government as largest single user of energy in US to adopt technologies as soon as practicable. These may include lease as well as purchase arrangements.

Details of Financial Incentives

Fuel Cell Investment Tax Credit

	Business Property Owner **Section 1336**	**Non-Business Property Owner** **Section 1333**
Credit	$1,000 / kW or 30% whichever is less	$1,000 / kW or 30% whichever is less
Size	Minimum of 0.5 kW capacity	Minimum of 0.5 kW capacity
Efficiency	Electricity only efficiency of more than 30%	Electricity only efficiency of more than 30%
Effective Dates[1]	1-1-06 — 12-31-07	1-1-06 — 12-31-07
Definition of Fuel Cell Power Plant	"Integrated system comprised of a fuel cell stack assembly and associated balance of plant components which converts a fuel into electricity using electrochemical means."	"Integrated system comprised of a fuel cell stack assembly and associated balance of plant components which converts a fuel into electricity using electrochemical means."
Telecommunications Eligibility	Telecom eligible for credit.	Not applicable

Table 4

Renewable Energy Production Credit (Section1301)

- Extended for two years (expires January 1, 2008)
- Incentive level of 1.5 cents per kilowatt-hour adjusted for inflation. Rate for 2005 is 1.9 center per kWh.

Advanced Power System Technology production incentive (Section 1224)

- Provides incentive of 1.8 cents per kWh for operators of advanced power generation technologies including "advanced fuel cell, turbine, or hybrid power system or power storage system to generate or store electric energy."
- Premium of 0.7 cents provided for critical governmental, industrial, or commercial applications (determined by Secretary of Energy and Secretary of Homeland Security).
- Incentive limited to first 10 million kilowatt hours produced in any fiscal year.
- Total of $70 million authorized over seven years.

Renewable Electricity Production incentive (Section 202)

[1] Equipment placed in service during the taxable year

5 A Pilot Program

This report extols the virtues and values of tax credits, but in real context, one must build a model tailored to take advantage of these opportunities. By unpacking this report, intuition and logic infers that cell site operators possess the key competencies required to succeed. Creative business models provide access to any competencies and resources necessary for that success. However, one must realize that only a fraction of the value of using the fuel cell is created by building and operating a few sites powered by fuel cells. The greater part of the value is created by managing tax incentives, by building and employing political and regulatory capital, by marketing and trading renewable energy, and by managing the various credits associated with such an opportunity.

It would be foolish to try to predict the exact course of federal and state legislation and regulation affecting the use of fuel cells, but uncertainty is not a basis for passivity.

In September 2000, Assembly Bill 970 (AB 970) was approved, which called for the creation of more energy supply and demand programs. As a result, in March 2001, the California Public Utilities Commission (CPUC) issued a decision creating the Self-Generation Incentive Program (SGIP) to offer financial incentives to their customers who install certain types of distributed generation facilities to meet all or a portion of their energy needs. In late 2003, AB 1685 extended the SGIP through 2007.

Generation must be certified to operate in parallel with the electric system grid (not back-up generation) and meet other criteria established by the CPUC. While residential customers are not barred from the program, it is designed primarily with business and large institutional customers in mind. The CPUC also created a parallel program that is available to customers who install renewable generation, such as photovoltaics, wind turbines, and fuel cells smaller than 30 kWe. It is called the Emerging Renewables Program which was created to help develop a self-sustaining market for renewable energy systems that supply on-site electricity needs across California. Only solar-thermal electric and fuel cells using a renewable fuel are offered $3.20 per watt.

This study will assume fuel cells will be installed in 100 cell towers as primary power in the Sacramento area to demonstrate the efficacy of the Altergy Systems fuel cell system. The electric utility participating will provide power as a backup to the fuel cell. Each location identified will participate in the demonstration program and financed collectively through tax incentives, buy-down programs, utility incentives, research institute participation, and finally, Sprint/Nextel's host sites.

5.1 Program Concept System Connectivity

Process control systems are used extensively throughout the electricity, oil, and gas sectors to monitor and control processes that generate, transmit, transport, and distribute energy. They encompass a variety of digital control systems, supervisory control and data acquisition systems (SCADA), and other equipment and systems that are integral to modern energy production and delivery. While these systems enable accurate and efficient control of large energy systems, they may be vulnerable to malicious cyber and physical attacks. As systems become increasingly interconnected, concern about the potential for widespread service disruptions has grown.

As with any system, connectivity between all points of information is necessary. From the thermal producing devices to energy production, and on to the grid interface, all systems must operate in a synchronous and fluid motion. All points need to be managed and controlled.

U.S. Investment in New Electric Power Transmission
(Millions of 1990 Dollars)

Growth in peak demand for electricity has far outstripped investment in transmission capacity. As a result, transmission constraints could aggravate already limited supplies of power and could result in high prices in some areas of the country.

Source: PA Consulting Group, based on data from the UDI data base

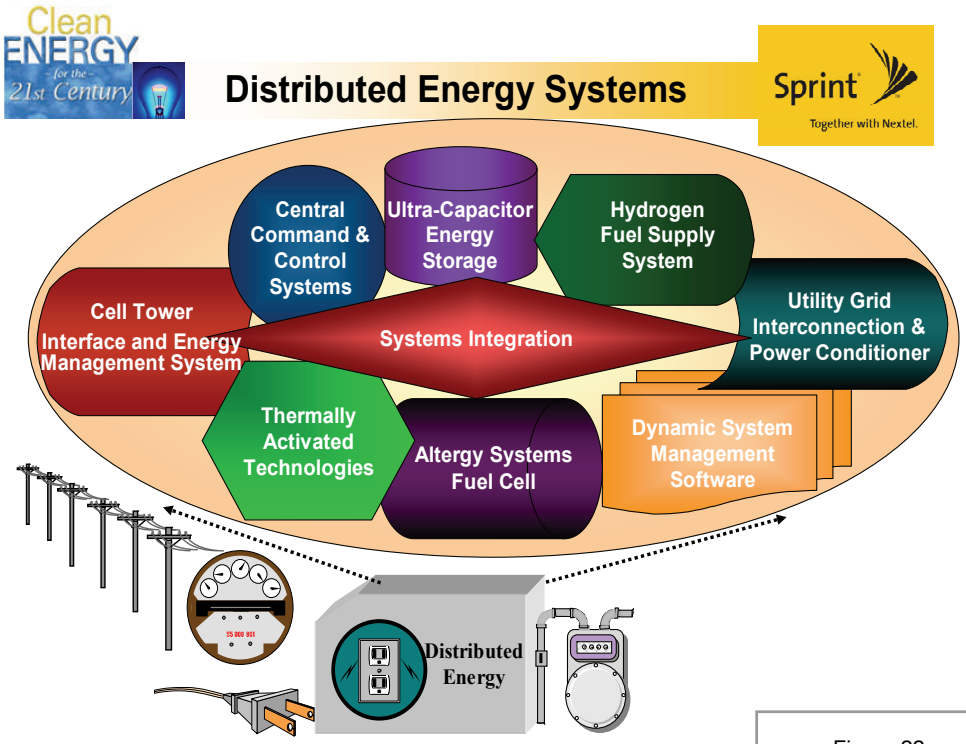
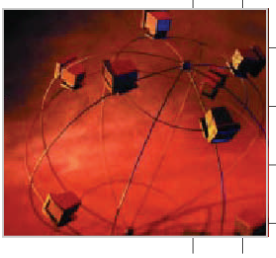


Figure 22

Using the power of distributed intelligence and advanced communications software, there are packaged systems which facilitate a seamless Supervisory Control and Data Acquisition (SCADA) system. One such platform that offers SCADA performance and configurability is the Comverge 6D iNET, which is a low-cost solution (Figure 28) which allows real-time energy collection,

Overall the fuel cell by itself is not a system but only one component of a power system as depicted in Figure 26. The system is made up of many interrelated components which should be viewed as an integrated organism freely communicating through a hierarchy of control. A schematic of the system is best illustrated in Appendix D.



In other words, from a micro-view of the power system design, it is only one component of many individual sites in a macro-system of nationwide cell towers as depicted in Figure 27. Master control of the power systems have imbedded points of connectivity which seamlessly integrates, monitors, and manages the entire system from a Sprint-Nextel control-center.

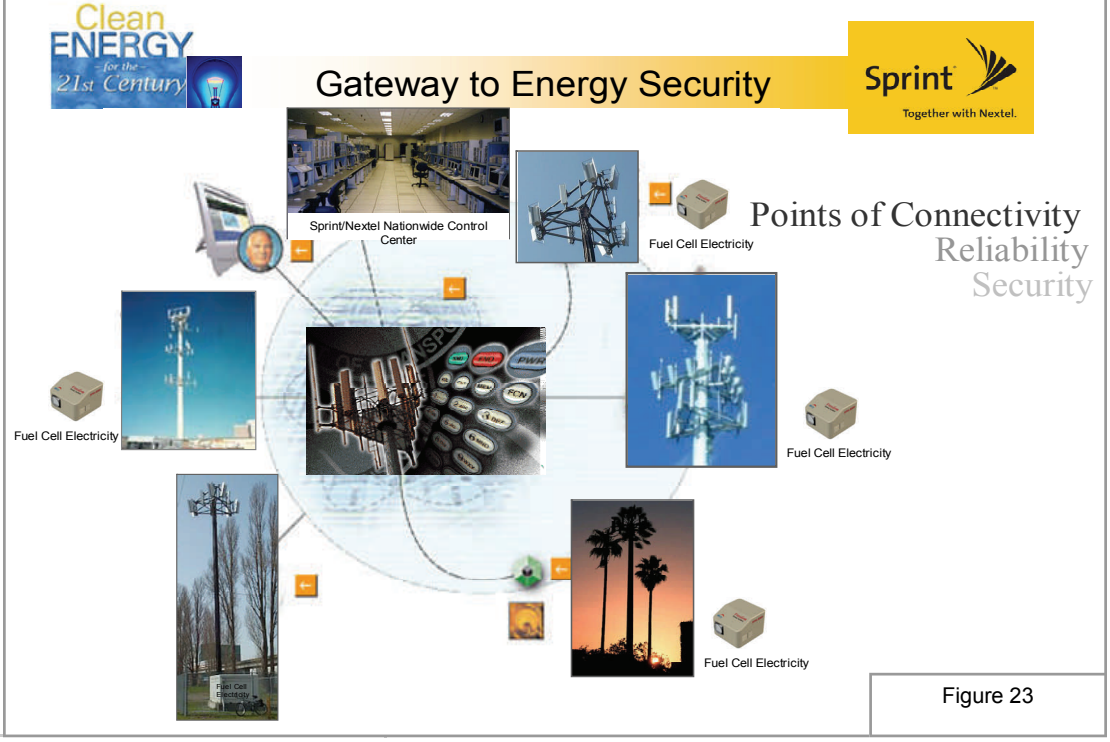


Figure 23

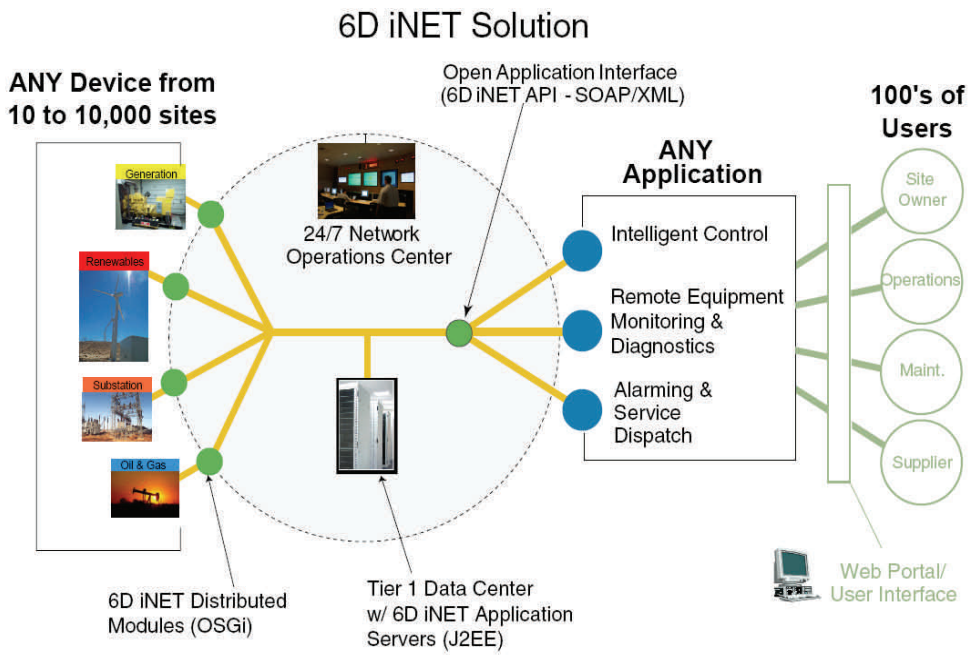


Figure 24

Nextel's cell towers.

Under the program the following parameters would be considered:

- No capital investment for the installation of the fuel cells
- The Customer (host site) purchase power as an outsourced commodity
- Customer has no risk of operation, performance, maintenance, or replacement
- Transaction is an off-book asset
- No investment risk
- No ownership risk
- Negotiated off-ramps of contract
- PG&E is backup to the fuel cell system

system compliance monitoring, energy market interface, performance diagnostics and remote fault notification to name a few.

The Comverge 6D iNET system is used nationwide. It is certified by the California Independent System Operator and accepted by all utilities in the State.

5.2 Outsourced Utility Concept

For the purposes of this section of the report, it is assumed the fuel cell would serve as primary power for the 100 selected cell sites. This is not to say that a parallel track of backup power implementation would not be undertaken—only that an economic scenario for primary power is compelling enough for a 3rd party ownership structure be fully investigated.

Outsourcing a commodity is not a new concept—only a unique methodology to implement a nationwide rollout of a primary/backup system for Sprint/

Figure 29 diagrams the process flow and highlights the main features of the outsourced commodity/utility concept. The following steps could fully implement the outsourced commodity transaction:

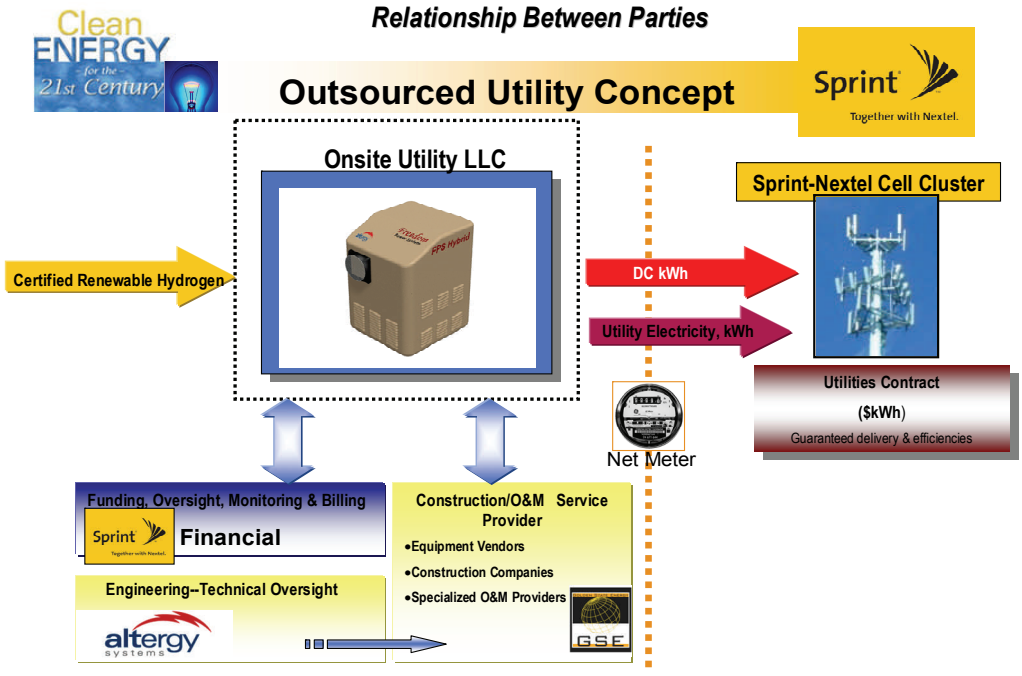


Figure 25

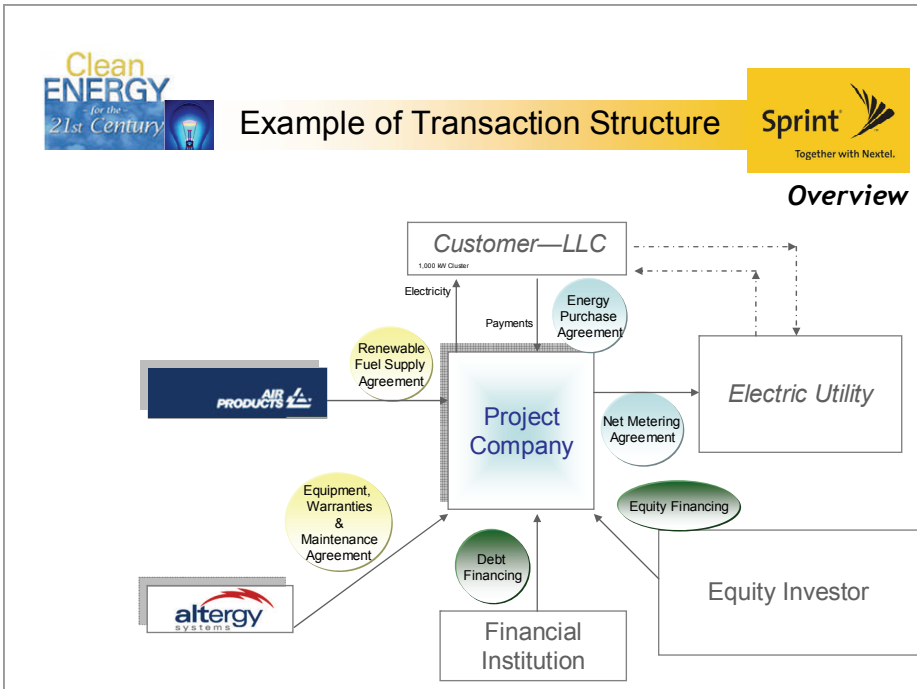


Figure 26

A Special Purpose Entity (SPE) is formed as an LLC which is established for the project. The SPE is managed (for purposes of discussion) by Golden State Energy (GSE or any other company for that matter.)

- ✓ GSE provides all the required capital, management, engineering, technical, vendor, insurance, risk mitigation, and fuel sourcing input to the Project SPE.
- ✓ The Project SPE will own the power generation assets (although title may be held by the Lender for collateral and rate reduction purposes) and provide power and possibly thermal commodities to the Customer at a discount from their current utility provider.
- ✓ The Project SPE invoices the Customer on a monthly basis for the commodity power and thermal just as they would from their current utility provider.
- ✓ The SPE via Lender Lock-Box oversight) authorizes payment of utilities, fuel, subcontractors, and other life-cycle project payables.
- ✓ The SPE is bonded and insured—financing, fuel, insurance, taxes and other costs will always be paid with asset risks adequately mitigated

Figure 30 illustrates an example of a typical transaction structure for the LLC.

Evolutionary steps necessary for a successful transaction (outlined in Figure 31) include the following:

- ✓ GSE will prepare a Target Commodity Power and Thermal Price and a Letter of Intent (LOI)
- ✓ GSE and Customer agree on Power and Thermal Pricing and LOI
- ✓ LOI Negotiation/Execution (commitment by both parties to proceed with project development and due diligence process)
- ✓ GSE conducts economic/design/fuel/legal/permitting/financing due diligence and prepares the Energy Service Agreement
- ✓ GSE and Customer negotiate and execute the Energy Services Agreement

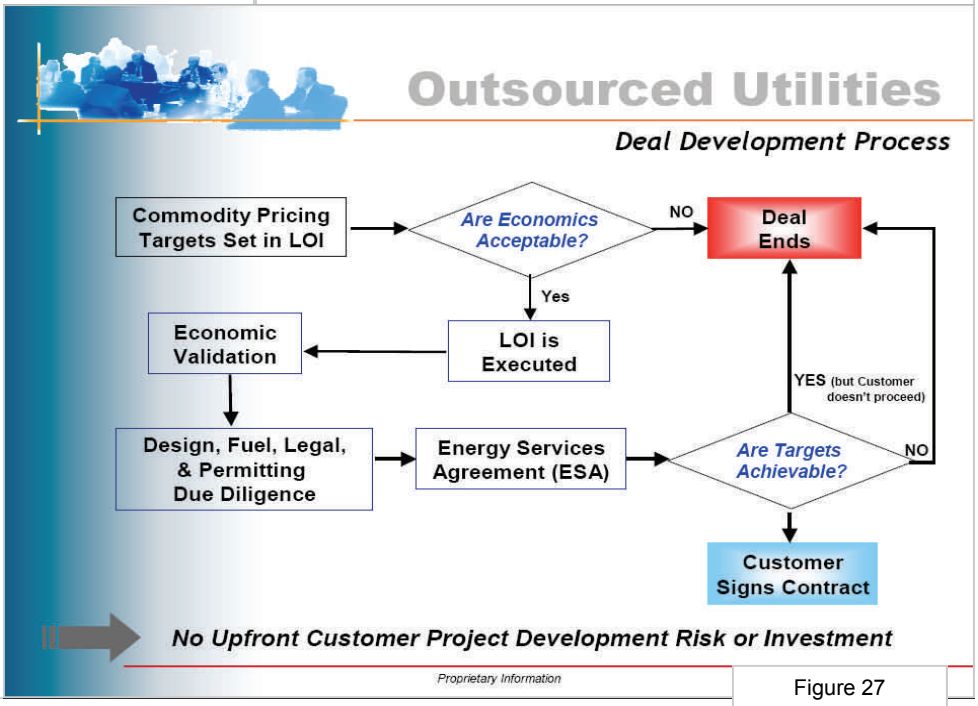


Figure 27

5.3 Sprint/Nextel Public-Private Partnership

Whichever methodology of finance is ultimately selected, it is clear that support for such an undertaking be coordinated with governmental entities since many agencies desire to participate in various partnerships. Some entities have discretionary funds available for these types of projects. They include, but are not limited to:

- Local Utility
- State Government
- Federal Government
- Electric Power Research Institute
- Gas Research Institute
- Academic (Fuel Cell) Research Institutes
- Hydrogen/Fuel Cell Associations
- Air Quality Management Districts
- Interested Private Companies

5.4 California Utility Districts

California has three major Investor Owned Utilities (IOU) serving most of the State. They include San Diego Gas & Electric, Southern California Edison, and Pacific Gas & Electric. Appendix B on page 39 is a map of California's IOU's and municipal utilities.

This report uses the 3rd Party Outsourced Utility program which focuses on Pacific Gas & Electric since their service territory is near Sacramento and near Altergy Systems offices for close technical observations.

Pacific Gas and Electric Company (PG&E) incorporated in California in 1905 is one of the largest combination natural gas and electric utilities in the United States. They are a subsidiary of PG&E Corporation serving 15 million people in a 70,000 square mile service area.

PG&E offers a "net-metering" program entitled "Electric Rate Schedule E-Net—Net Energy Metering," that allows customers to install their own solar, wind, fuel cell, or hybrid generation that is interconnected to, and operates in parallel with the electric grid. The primary purpose of such generation is to offset part or all of the customers electric needs.

6 Summary

America's critical infrastructure facilities are in essence, the foundation for economic vitality, national security, governance, and a way of life that we have enjoyed since the birth of our country. Developing and implementing a robust strategy to ensure the security of the country's critical infrastructure and key assets requires a comprehensive assessment of facilities to identify vulnerabilities. Rational engineering measures can then reduce these vulnerabilities or mitigate the impact of an extraordinary event.

In the case of communications and cell towers, fuel cells and hydrogen will become the backbone of the cellular system. Fuel cells and hydrogen are riding some of the most powerful historical trends. Throughout history, mankind's energy use has moved towards a higher hydrogen ratio in the chemical composition of the fuel and a reduction in the other components. Starting with wood, then to coal, oil and natural gas, society's shift in type of fuel is simply a movement along a hydrocarbon chain. As the form of the fuel changed, more of the carbon, from which a significant percentage of the pollution associated with fossil fuels originates from, was eliminated. Hydrogen and fuel cells complete the process of eliminating the dirty carbon and finish the task of employing pure, clean hydrogen. Aside from history, fuel cells and hydrogen are riding the momentum created by an increased environmental awareness, the inevitable extinction of our fossil fuel reserves, sound economic policy and the optimism of the stock market.

The centralization paradigm that has guided the generation of electricity over the past century is slowly breaking down as a result of new distributed generation technologies and progressive regulatory changes — such as net metering rules. The latest rules all but eliminate most of the administrative roadblocks to distributed generation and energy security. Capital formation incentives are in place to encourage business and consumers to install renewable energy generators at their home or place of business. They are summarized as follows:

- **Investment incentives.** Primarily tax credits for qualifying facilities, these can be the biggest part of project value.
- **Production incentives.** Annual payments of 1.5 to 2.5 cents per kilowatt-hour may be granted fuel cells using renewable hydrogen, probably up to some aggregate limit. Local considerations may result in preferential treatment for certain technologies.
- **Renewable portfolio standards (RPS).** These quotas, usually ramped up over 2005 – 2020, vary from 4 to 10 percent of supply with outliers such as California calling for 20 percent. At the high end, the quotas might crowd out otherwise economical additions of conventional capacity.
- **Compliance responsibility and penalties.** Who is subject to the RPS – the utility that buys power for retail delivery or the wholesale power seller –varies across proposals. In California it is the retail seller (utility); under proposals in New Jersey, responsibility may fall on the wholesale power seller. RPS compliance penalties also vary from state to state.
- **Renewable energy credits (REC).** In many proposals, a separable and tradable REC would be issued for

each kWh produced by a qualifying facility. Marketing and trading these credits is an area of potential advantage for utilities or their affiliates.

- **Qualifying facility definitions.** Renewable energy is usually defined to include wind, solar, biomass and hydroelectric, with some jurisdictions adding geothermal, tidal, landfill methane and many identifying fuel cells. New hydroelectric sites or dams are ineligible in some proposals. The definition of biomass is often narrowed to discourage incineration of recyclable materials such as paper. Not surprisingly, local economic interest can affect the definition of "renewable".
- **Federal or state purchase quotas.** Some proposals call for graduated federal electricity purchase standards up to 7.5 or 10 percent. State plans vary.

With the current state of development, the Altergy Systems fuel cell is ready for commercialization. With governmental support of such a technology and the economics involved, it would be a prudent decision to move forward with first a demonstration of concept, then a full rollout of the technology on a nationwide basis powering cell towers.

6.1 Conclusion

In powering cell sites, operators of cell sites are at the mercy of the utility grid and the inherent vagaries of reliability and power quality. If a cell site, or series of cell sites fail to work due to a local power outage, the penalty is lost revenues, not counting the human costs for loss of service. Since utility companies have no responsibility nor obligation to serve, it is imperative that cell site owners provide some type of backup power system to assure system availability.

If a person could see into the future, one would see that fuel cells will become ubiquitous as the cell phone itself. Fuel cells are a technology with a proven availability record. In the case of NASA, fuel cell reliability is imperative since fuel cells are used extensively in the space program. Some of the early fuel cells in stationary applications proved to have 98 percent availability, while others broke many world records for extended hours of operation without maintenance. Competing technologies cannot "hold a candle" to this record.

Altergy Systems has a proven methodology to reduce the initial cost of a fuel cell. They have a pathway to further reducing the cost but already have a technology with the ability to compete with current technology prices.

Given the current governmental incentives, the initial price of the fuel cell is reduced to near the cost of an internal combustion engine, all without producing greenhouse gasses nor the hazards inherent in hydrocarbon based fuels. Batteries and flywheels are only temporary fixes for a short-term outage or power-sags.

WHY FUEL CELLS

The demand for abundant, reliable and environmentally safe energy is increasing as our world and power needs expand. Today, much of our electricity is generated at central station power plants using nonrenewable, imported fuels and transmitted to various sites by transmission and distribution lines.

To address these needs and vulnerabilities, California has committed to increasing the generation of power from renewable resources from the current level of 12 percent to 20 percent by the year 2010. In addition, the Governor is committed to investing in clean generation and cogeneration at the site where the electricity is needed. This is referred to as distributed generation, a term used for a decentralized approach to generating electricity. The advantages of distributed generation are

- Increased reliability by producing power on-site
- Ability to utilize the heat generated by these systems in the form for heat, air conditioning, and hot water
- Gradual investment in energy generation, where it is needed most, when it is needed most
- Ability to use multiple fuels, including "opportunity fuels" like landfill gas or anaerobic digester gas from waste water treatment facilities
- The successful integration of fuel cell technology into the market in California is arguably one of the more effective strategies we can take to resolve the energy and environmental challenges we face in California today.

Fuel cells operate silently as long as there is a fuel source. Hydrogen is a common commodity with many sources. Some sources render hydrogen as a low-cost fuel competing with the price of natural gas.

Hydrogen is the central focus of a national effort to reduce our dependence on oil-based fuels. Greenhouse gases are a worldwide focus to reduce the overall emissions—fuel cells produce only water through their electro-chemical process. Greenhouse gas offsets are available and have an economic value which this report does not quantify.

In conclusion, the PEM fuel cell is the best technology with an ability to dispatch power at-will almost instantaneously. The Altergy Systems integrated fuel cell system has the ability to not only dispatch power at-will, but it can also provide load-shedding component through the Internet based control system.

References

Energy Information Administration, Department of Energy International Energy Annual 1996 available at: http://www.eia.doe.gov/emeu/iea/contents.html

Allen, W. (January 14, 2003) Power-Grid Independence Means Better Homeland Security, Global Energy Network Institute

Fama, J. (2004, April). Financial, regulatory fixes needed to entice grid investment. Electric Light & Power pp. 18-20.

Farrell, A. (2004, June). From Central Plants to Backyard Stations: UC Researchers Evaluate Distributed Electricity Generation Energy Notes, University of California Energy Institute 2 (3), pp. 1 - 3

Friend, T. (June 24, 2002) Power grid vulnerable to attack, report warns, USA Today

Nozik, K. (August 14, 2003) Rocky Mountain Institute, Eastern Power Outage Unfortunate but Entirely Predictable Aug. 14 Event Offers Wake-Up Call for U.S. Energy Policy Makers

International Energy Outlook 2003. Energy Information Administration, U.S. Department of Energy. (Viewed on 2/24/04 at www.eia.doe.gov/oiaf/ieo/world.html.)

Database of State Incentives for Renewable Energy. N.C. Solar Center, N.C. State University. (Viewed 3/04 at http://www.dsireusa.org.)

Rabe, Barry G. Greenhouse and Statehouse: The Evolving State Government Role in Climate Change. Pew Center on Global Climate Change: November 2002. (iv)

State Budget Update: February 2004. Fiscal Affairs Program, National Conference of State Legislatures. February 2004. (3)

Public Fuel Cell Alliance: Business Plan for Federal, State and International Collaboration on Fuel Cell Deployment and Hydrogen Infrastructure. Clean Energy Group, October 2003. (v)

Biographical

As a Certified Energy Manager and president of Golden State Energy in Carson City, Nevada, Thomas Damberger has over 23 years in the energy industry. He holds a Ph.D. is in Applied Management and Decision Sciences from Walden University—Minneapolis, a Master of Public Administration from California State University—Long Beach, and a Bachelor of Arts in Public Administration from San Diego State University.

Dr. Damberger installed several 200 kW phosphoric acid fuel cells for Kaiser Hospitals in California. He received the prestigious Clean Air Award from the South Coast Air Quality Management District, and Special Recognition for Outstanding Contribution in Promoting an Environmentally Sustainable Energy Future from the Secretary of Energy at the United States Department of Energy. More recently, after completing several CHP systems and sale of DG systems to an off-grid housing development, he is now working at improving the environmental conditions and performance of K-14 school district assets in California.

For more information:
www.goldenstateenergy.com

Appendix A

Glossary of Terms

Financial Incentives

Corporate Tax Incentives—Corporate tax incentives allow corporations to receive credits or deductions ranging from 10% to 35% against the cost of equipment or installation to promote renewable energy equipment. In some cases, the incentive decreases over time. Some states allow the tax credit only if a corporation has invested a certain dollar amount into a given renewable energy project. In most cases, there is no maximum limit imposed on the amount of the deductible ore credit.

Direct Equipment Sales—A few utilities sell renewable energy equipment to their customers as part of a buy-down, low-income assistance, lease, or remote power program.

Grant Programs—States offer a variety of grant programs to encourage the use and development of renewable energy technologies, while some states focus on promoting one particular type of renewable energy such as wind technology, fuel cells, or alternative fuels.

Grants are available primarily to the commercial, industrial, utility, education, and government sectors. Some grant programs focus on research and development, while others are designed to help a project achieve commercialization. Programs vary in the amount offered—from $500 to $1,000,000—with some states not setting a limit.

Industrial Recruitment Incentives—This category focuses on special efforts and programs designed to attract renewable energy equipment manufacturers to locate within a state or city. Renewable energy industrial recruitment usually consists of financial incentives like tax credits, grants, or a commitment to purchase a specific amount of the product for use by a government agency.

The recruitment incentives are designed to attract industries that will benefit the environment and create jobs. In most cases, the financial incentives are temporary measures that will help support the industries in their early years but include a sunset provision to encourage the industries to become self-sufficient within a number of years.

Leasing/Lease Purchase Programs—Utility leasing programs target remote power customers for which line extension would be very costly. The customers can lease the technology, e.g., photovoltaics, from the utility, and in some cases, the customer can opt to purchase the system after a specified number of years.

Loan Programs—Loan programs offer financing for the purchase of renewable energy equipment. Low-interest or no-interest loans for energy efficiency are a very common strategy for demand-side management by utilities. State governments also offer loans to assist in the purchase of renewable energy equipment. A broad range of renewable energy technologies are eligible. In many states, loans are available to residential, commercial, industrial, transportation, public, and nonprofit sectors. Repayment schedules vary; while most are determined on an individual project basis, some offer a 7-10 year loan term.

Personal Income Tax Incentives—Many states offer personal income tax credits or deductions to cover the expense of purchasing and installing renewable energy equipment. Some states offer personal income tax credits up to a certain percentage or predetermined dollar amount for the cost or installation or renewable energy equipment. Allowable credit may be limited to a certain number of years following the purchase or installation or renewable energy equipment. Eligible technologies may include solar and photovoltaic energy systems, geothermal energy, wind energy, biomass, hydroelectric, and alternative fuel technologies.

Production Incentives—Production incentives provide project owners with cash payments based on electricity production on a $/kWh basis, as is the case with the Federal Renewable Energy Production Incentive, or based on the volume of renewable fuels produced on a $/gallon basis, as is the case with a number of state ethanol production incentives. Payments based on performance rather than capital investments can often be a more effective mechanism for ensuring quality projects.

Property Tax Incentives—Property tax incentives typically follow one of three basic structures: exemptions, exclusions, and credits. The majority of the property tax provisions for renewable energy follow a simple model that provides the added value of the renewable device is not included in the valuation of the property for taxation purposes. That is, if a renewable energy heating system costs $1,500 to install versus $1000 for a conventional heating system, then the renewable energy system is assessed at $1000.

Property taxes are collected locally, so some states allow the local authorities the option of providing a property tax incentive for renewable energy devices. Six states have such provisions: Connecticut, Iowa, Maryland, New Hampshire, Vermont, and Virginia.

Rebate Programs—Rebate programs are offered at the state, local, and utility levels to promote the installation of renewable energy equipment. The majority of the programs are available from state agencies and municipally-owned utilities and support solar water heating and/or photovoltaic systems. Eligible sectors usually include residents and businesses, although some programs are available to industry, institutions, and government agencies as well. Rebates typically range from $150 to $4000.

In some cases, rebate programs are combined with low or no-interest loans.

Sales Tax Incentives—Sales tax incentives typically provide an exemption from the state sales tax for the cost of renewable energy equipment.

Rules, Regulations & Policies

Construction and Design Policies—Construction and design policies include state construction policies, green building programs, and energy codes. State construction policies are typically legislative mandates requiring an evaluation of the cost and performance benefits of incorporating renewable energy technologies into state construction projects such as schools and office buildings. Many cities are developing "Green Building" guidelines that require or encourage consideration of renewable energy technologies.

Some guidelines are voluntary measures for all building types, while others are requirements for municipal building projects or residential construction. Local energy codes are used to achieve energy efficiency in new construction and renovations by requiring that certain building projects surpass state requirements for resource conservation. Incorporating renewables is one way to meet code requirements.

Contractor Licensing—Many states have rules regarding the licensing of renewable energy contractors. Contractor licensing requirements can be enacted for solar water heat, active and passive solar space heat, solar industrial process heat, solar thermal electricity, and photovoltaics. These requirements--where they do exist--are designed to ensure that contractors have the necessary experience and knowledge to properly install systems.

Equipment Certifications—Statutes requiring renewable energy equipment to meet certain standards are generally seen as a tool for reducing the chance that consumers will be sold inferior equipment. Beyond being a consumer protecting measure, equipment certification benefits renewables by reducing the number of problem systems and the resulting bad publicity.

Generation Disclosure Rules—"Disclosure" typically refers to the requirement that utilities provide their customers with additional information about the energy they are supplying. This information often includes fuel mix percentages and emissions statistics. Fuel mix information, for example, can be presented as a pie chart on customers' monthly bills. "Certification" is a related issue which refers to the assessment of green power offerings to assure that they are indeed utilizing the type and amount of renewable energy as advertised. One example of green power certification is the *Green-e* stamp.

Both disclosure and certification are designed to help consumers make informed decisions about the energy and supplier they choose. It is worth noting, though, that two states that have not moved ahead with restructure--Florida and Colorado--have enacted disclosure provisions. Indeed, disclosure is often thought of as a good policy to help educate customers about electricity and thereby to prepare markets in advance of retail competition.

Green Power Purchasing/Aggregation Policies—Municipalities, state governments, businesses, and other non-residential customers can play a critical role in supporting renewable energy technologies by buying electricity from renewable resources. At the local level, green power purchasing can mane buying green power for municipal facilities, streetlights, water pumping stations and the like.

Several states require that a certain percentage of electricity purchased for state government buildings come from renewable resources. A few states allow local governments to aggregate the electricity loads of the entire community to purchase green power and even to join with other communities to form an even larger green power purchasing block. This is often referred to as "Community Choice". Green power purchasing can be achieved via utility green pricing programs, green power marketers (in states with retail competition), special contracts, or community aggregation.

Line Extension Analysis—When an electric customer requests service for a location not currently serviced by the electric grid, they are charged a distance-based fee for the cost of extending power lines to their load. In many cases it is cheaper to have an on-site renewable energy system to meet their electricity needs. Certain states require utilities to provide their customers with information on renewable energy options when a line extension is requested.

Net Metering Rules—For those consumers who have their own electricity generating units, net metering allows for the flow of electricity both to and from the customer through a single, bi-directional meter. With net metering, during times when the customer's generation exceeds his or her use, electricity from the customer to the utility offsets electricity consumed at another time. In effect, the customer is using the excess generation to offset electricity that would have been purchased at the retail rate. Under most state rules, residential, commercial, and industrial customers are eligible for net metering, but some states restrict eligibility to particular customer classes.

Public Benefit Funds—Public Benefit Funds (PBF) are typically state-level programs developed through the electric utility restructuring process as a measure to assure continued support for renewable energy resources, energy efficiency initiatives, and low-income support programs. (These funds are also frequently referred to as a system benefits charge, or SBC). Such a fund is most commonly supported through a charge to all customers on electricity consumption, e.g., 0.2 cents/kWh. Examples of how the funds are used include: rebates on renewable energy systems; funding for renewable energy R&D; and development of renewable energy education programs.

Renewables Portfolio Standards/Set Asides— Renewables Portfolio Standards (RPS) require that a certain percentage of a utility's overall or new generating capacity or energy sales must be derived from renewable resources, i.e., 1% of electric sales must be from renewable energy in the year 2008. Portfolio Standards most commonly refer to electric sales measured in megawatt-hours (MWh), as opposed to electric capacity measured in megawatts (MW). The term "set asides" is frequently used to refer to programs where a utility is required to include a certain amount of renewables capacity in new installations.

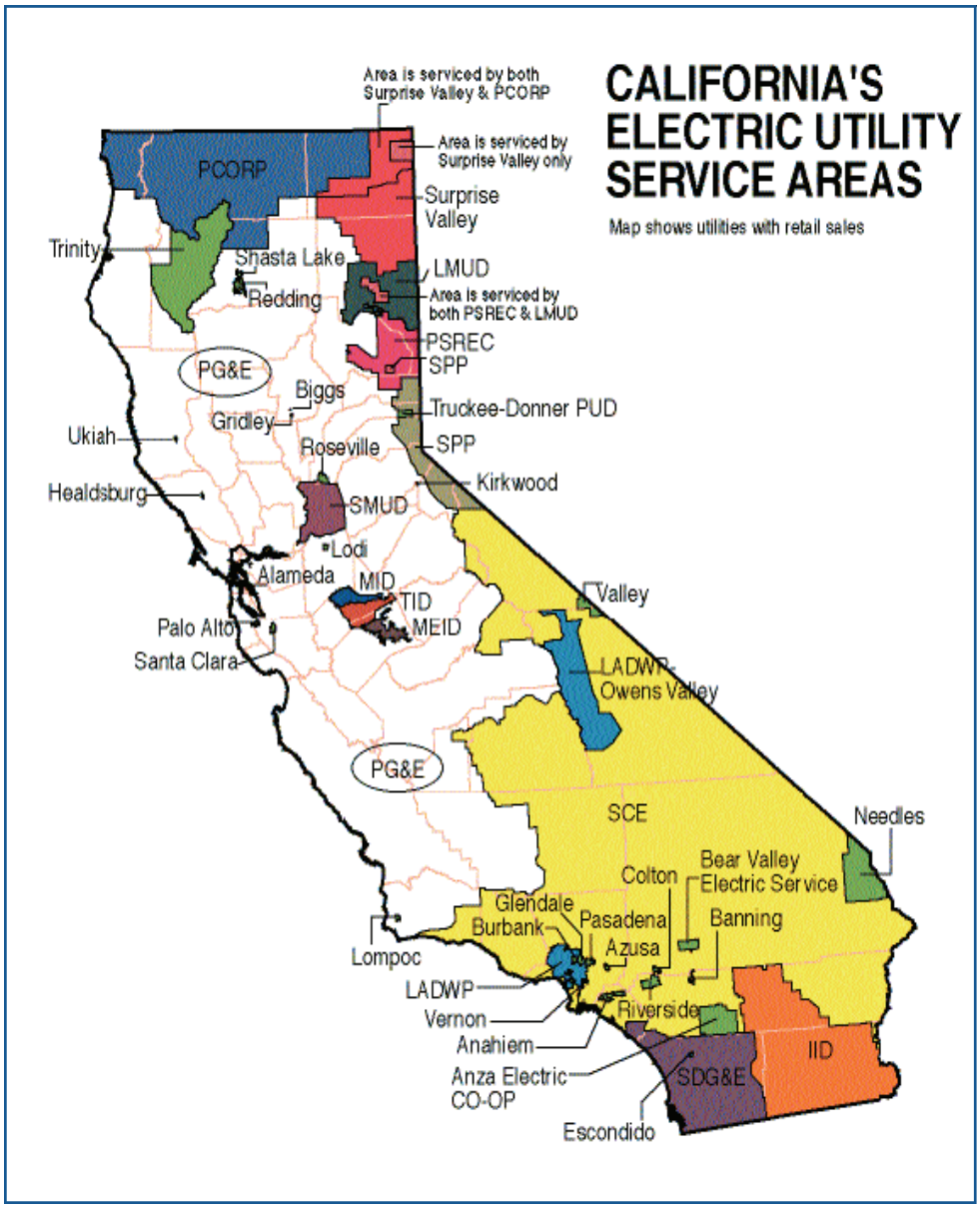
Required Utility Green Power Option—A handful of states require certain classes of utilities to offer customers the option to purchase power generated from renewable sources. Typically, utilities may provide green power using renewable resources they own or for which they contract; or they may purchase credits from a renewable energy provider certified by the state's Public Utilities Commission.

Solar and Wind Access Laws—These statutes provide for solar or wind easements or access rights. Easements allow for the rights to existing access to a renewable resource on the part of one property owner to be secured from an owner whose property could be developed in such a way as to restrict that resource. This easement is transferred with the property title. Access rights, conversely, automatically provide for the right to continued access to a renewable resource. Solar easements are the most common type of state solar access rule. Furthermore, some states prohibit neighborhood covenants that preclude the use of renewables.

At the local level, communities use many different mechanisms to protect solar access, including solar access ordinances, development guidelines requiring proper street orientation, zoning ordinances that contain building height restrictions, and solar permits.

Appendix B

Electric Utility Companies in California



Appendix B

Electric Utility Companies in California

ELECTRIC UTILITIES	ADDRESS	P.O. BOX	CITY	STATE	ZIP	TELEPHONE	WEBSITE
Investor-Owned Utility Companies							
Pacific Gas and Electric Company (PG&E)	77 Beale Street		San Francisco	CA	94105	(415) 973-7000	www.pge.com
Pacific Power - Corporate Offices	825 NE Multnomah		Portland	OR	97232	(503) 813-5000	www.pacificorp.com
San Diego Gas & Electric (SDG&E)	101 Ash Street		San Diego	CA	92101	(619) 696-2000	www.sdge.com
Sierra-Pacific Power		P.O. Box 10100	Reno	NV	89520	(775) 689-4011	www.sierrapacific.com
Southern California Edison (SCE)		P.O. Box 800	Rosemead	CA	91770	(818) 302-1212	www.sce.com
Municipal Utility Districts							
California Municipal Utilities Association	915 L Street Suite 1460		Sacramento	CA	95814-3705	(916) 441-1733	www.cmua.org
Alameda Power & Telecom	2000 Grand Street	P.O. Box H	Alameda	CA	94501-0263	(510) 748-3900	www.alamedapt.com
Anaheim Public Utilities Department	201 South Anaheim Blvd		Anaheim	CA	92803	(714) 765-3300	www.anaheim.net
Azusa Light & Water Department	729 North Azusa Avenue		Azusa	CA	91702	(626) 812-5225	www.azusa.ca.gov
Banning Electric Department	176 East Lincoln	P.O. Box 998	Banning	CA	92220	(909) 922-3260	http://paladin.cirrus.co.riverside.ca.us/city/banning
Biggs Electrical Department		P.O. Box 307	Biggs	CA	95917	(530) 868-5493	
Burbank Public Service Department	164 West Magnolia Blvd.		Burbank	CA	91503-0631	(818) 238-3700	
City of Coalinga (Gas Service)	155 West Durian Street		Coalinga	CA	93210	(559) 935-1533	
East Bay Municipal Utility District		P.O. Box 24055	Oakland	CA	94623-1055	(510) 835-3000	www.ebmud.com
Glendale Public Service Department	141 North Glendale Avenue		Glendale	CA	91206	(818) 545-4332	www.glendale.ci.ca.us
Gridley Municipal Utilities	685 Kentucky Street		Gridley	CA	95948	(530) 846-3631	
Healdsburg Municipal Electric Dept.	401 Grove Street	P.O. Box 578	Healdsburg	CA	95448	(707) 431-3346	
Hetch Hetchy Water & Power - City & County of San Francisco	1155 Market Street, 4th Floor		San Francisco	CA	94103	(415) 554-0725	
Lodi Municipal Electric System	1331 South Ham Lane	Call Box 3006	Lodi	CA	95242	(209) 333-6762	www.lodielectric.com
Lompoc Utility Services/Electrical	100 Civic Center Plaza		Lompoc	CA	93438	(805) 736-1261	www.ci.lompoc.ca.us
Long Beach Gas Department	2 East Spring Street		Long Beach	CA	90806	(562) 570-2000	www.ci.long-beach.ca.us/gas
Los Angeles Department of Water & Power	111 North Hope Street		Los Angeles	CA	90051-0100	(213) 481-5411 or 1-800-342-5397	www.ladwp.com
City of Needles	817 Third Street		Needles	CA	92363	(760) 326-2113	
Palo Alto Electric Utility	250 Hamilton Avenue		Palo Alto	CA	94301	(650) 329-2161	www.ci.palo-alto.ca.us
Pasadena Water and Power Department	150 South Los Robles Avenue	Suite 200	Pasadena	CA	91101	(626) 744-4409	www.ci.pasadena.ca.us/waterandpower/
Riverside Utilities Department	3900 Main Street		Riverside	CA	92522	(909) 782-5781	www.ci.riverside.ca.us/utilities
Roseville Electric Department	2090 Hilltop Circle		Roseville	CA	95747	(916) 774-5600	
Sacramento Municipal Utility District	6201 S Street	P.O. Box 15830 - 95852-1830	Sacramento	CA	95817-1899	(916) 452-7811	www.smud.org
Santa Clara Electric Department	1500 Warburton Avenue		Santa Clara	CA	95050	(408) 984-3044	www.alphais.com/santa-clara/3101.html
Ukiah Municipal Utility District	300 Seminary Avenue		Ukiah	CA	95482	(707) 462-2971	www.ukiah.ca.us
Vernon Municipal Light Department	4305 Santa Fee Avenue		Vernon	CA	90058	(323) 583-8811	www.vernongov.org

Appendix B

Electric Utility Companies in California

ELECTRIC UTILITIES	ADDRESS	P.O. BOX	CITY	STATE	ZIP	TELEPHONE	WEBSITE
Rural Electric Cooperatives							
Anza Electric Cooperative, Inc.		P.O. Box 391909	Anza	CA	92539	(909) 763-4333	
Plumas Sierra	73233 Highway 70		Portola	CA	96122	(530) 832-4261	www.psln.com/psrec
Surprise Valley Electrification Corp.		P.O. Box 691	Alturas	CA	96101	(530) 233-3511	
Federal and State Agencies and Irrigation District Systems							
U.S. Bureau of Reclamation - Department of the Interior - Federal Office	2800 Cottage Way		Sacramento	CA	95825-1898	(916) 978-5000	www.usbr.gov
California - Bureau of Reclamation - Energy Division	1416 Ninth Street	P.O. Box 942836	Sacramento	CA	94236-0001	(916) 445-6687	www.usbr.gov
Central California Power Agency	9500 Coldwater Creek Road		Kelseyville	CA	95451	(916) 732-6200	
Imperial Irrigation District	333 East Barioni Blvd.	P.O. Box 937	Imperial	CA	92251	(760) 339-9225	www.iid.com
Lassen Municipal Utility District	65 South Roop Street		Susanville	CA	96130	(530) 257-4174	
Merced Irrigation District		P.O. Box 2288	Merced	CA	95344	(209) 722-5761	www.mercedid.org
Modesto Irrigation District	1231 11th Street	P.O. Box 4060 - 95352	Modesto	CA	95354	(209) 526-7452	www.mid.org
Nevada Irrigation District - Yuba-Bear River Project	28311 Secret Town Road		Colfax	CA	95713	(530) 273-8571	yubabear@foothill.net
Northern California Power Agency	180 Cirby Way		Roseville	CA	95678	(916) 781-3636	www.ncpa.com
Oroville/Wyandotte Irrigation District		P.O. Box 581	Oroville	CA	95965-0581	(530) 534-1221	
Placer County Water Agency		P.O. Box 667	Foresthill	CA	95631	(530) 885-6917	
Shasta Dam Public Utilities District		P.O. Box 777	Central Valley	CA	96019	(530) 275-8827	
Transmission Agency of Northern California		P.O. Box 661030	Sacramento	CA	95866	(916) 924-1196	
Trinity County Public Utility District		P.O. Box 1216	Weaverville	CA	96093	(530) 623-5536	
Truckee-Donner Public Utilities District	11570 Donner Pass Road		Truckee	CA	96161	(530) 587-3896	tdpud@telis.org
Turlock Irrigation District	333 East Canal Drive	P.O. Box 949	Turlock	CA	95381	(209) 883-8300	www.tid.org
Yuba County Water Agency	1402 D Street		Marysville	CA	95091	(916) 741-6278	

Appendix C

Summary of State Net Metering Programs

This Table was last updated on 7/12/2004

State	Allowable Technology and Size	Allowable Customer	Statewide Limit	Treatment of Net Excess Generation (NEG)	Authority	Enacted	Scope of Program	Citation/ Reference
Arizona	<10 kW; eligible technologies vary by utility	All customer classes	None	Annual NEG granted to utility	ACC; Utility Tariffs	1981	SRP and TEP	PUC Order Decision 52345, Docket 81-045, Utility tariffs
Arkansas	Renewables, fuel cells and microturbines <25 kW residential <100 kW commercial	All customer classes	None	Monthly NEG granted to utilities	Legislature	2001	All utilities	HB 2325, effective Oct. 2001; PSC Order No. 3 July 3, 2002
California	Solar, fuel cell, and wind <1000 kW	All customer classes	0.5% of utilities peak demand	Annual NEG granted to utilities	Legislature	2002; 2001; 1995	All utilities	Public Utilities Codes Sec. 2827 (amended 09/02; 04/01; effective 9/98)
Colorado	Wind and PV 3 kW, 10 kW	Varies	NA	Varies	Utility tariffs	1997	Four Colorado utilities	PSCO Advice Letter 1265; PUC Decision C96-901 [1]
Connecticut	Renewables and fuel cells <100kW	Residential	None	Not specified	Legislature	1990, updated 1998	All IOUs, No REC in state.	CGS 16-243H; Public Act 98-28
Delaware	Renewables <25kW	All customer classes	None	Not specified	Legislature	1999	All utilities	Senate Amendment No. 1 to HB 10
Florida	JEA: PV and wind <10 kW	JEA: Residential only; NSB: All customer classes	None	JEA and NSB: Monthly NEG granted to customer	Individual Utility Tariffs	2003 (JEA)	JEA, New Smyrna Beach	Individual Utility Tariffs
Georgia	Solar, wind, fuel cells <10 kW residential <100 kW commercial	Residential and commercial	0.2% of annual peak demand	Monthly NEG or total generation purchased at avoided cost or higher rate if green priced	Legislature	2001	All utilities	SB93
Hawaii	Solar, wind, biomass, hydro <50kW	Residential and small commercial	0.5% of annual peak demand	Monthly NEG granted to utilities	Legislature	2001	All utilities	HB 173; amended HB 2048 (2004)
Idaho	Eligible technologies vary by utility <25 kW residential <100 kW commercial (Avista <25 kW)	Residential and small commercial	None	NEG varies by utility	Public Utility Commission	1980	IOUs only, RECs are not rate-regulated	Idaho PUC Order #16025 and #26750 (1997) Tariff sheets 86-1 thru 86-7
Illinois	Solar and wind <40kW	All customer classes; ComEd only	0.1% of annual peak demand	NEG purchased at avoided cost	ComEd tariff	2000	Commonwealth Edison	Special billing experiment [1]
Indiana	Renewables and cogeneration <l,000 kWh/month	All customer classes	None	Monthly NEG granted to utilities	Public Utility Commission	1985	IOUs only, RECs are not rate-regulated	Indiana Administrative Code 4-4.1-7
Iowa	Renewables and cogeneration (No limit per system)	All customer classes	105 MW	Monthly NEG purchased at avoided cost	Iowa Utility Board	1993	IOUs only, RECs are not rate-regulated[2]	Iowa Administrative Code [199] Chapter 15.11(5)
Kentucky	Residential PV < 15 kW	Not specified	0.1% of a supplier's single-hour peak load for previous year	Monthly NEG granted to customer	Legislature	2004	IOUs and RECs	SB 247 (2004)

Appendix C

Summary of State Net Metering Programs

This Table was last updated on 7/12/2004

State	Allowable Technology and Size	Allowable Customer	Statewide Limit	Treatment of Net Excess Generation (NEG)	Authority	Enacted	Scope of Program	Citation/ Reference
Louisiana	Residential <25 kW; <100 kW commercial and farm	Residential, commercial, farm	None	Not specified	Legislature	2003	All utilities	HB 789 (2004)
Maine	Renewables and fuel cells <100 kW	All customer classes	None	Annual NEG granted to utilities	Public Utility Commission	1998	All utilities	Order # 98-621 RC of ME Chapter 36
Maryland	Solar and wind <80kW	Residential, commercial, and nonprofit	0.2% of 1998 peak	Monthly NEG granted to utilities	Legislature	1997	All utilities	Article 78, Section 54M; amended SB 869 (2004)
Massachusetts	Qualifying facilities <60kW	All customer classes	None	Monthly NEG purchased at avoided cost	Legislature	1997	All utilities	Mass. Gen. L. ch. 164, §1G(g); Dept. of Tel. and Energy 97-111
Minnesota	Qualifying facilities <40kW	All customer classes	None	NEG purchased at utility average retail energy rate	Legislature	1983	All utilities	Minn. Stat. §216B.164
Montana	Solar, wind and hydro <50kW	All customer classes	None	Annual NEG granted to utilities at the end of each calendar year.	Legislature	1999	IOUs only	SB 409
Nevada	Biomass, geothermal, solar, wind, hydro <30kW	All customer classes	None	Monthly or annual NEG granted to utilities	Legislature	2001; 1997	All utilities	Nevada Revised Statute Ch. 704; amended AB661 (2001); amended PUC Order 12/13/2003
New Hampshire	Solar, wind and hydro <25kW	All customers classes	0.05% of utility's annual peak	NEG credited to next month	Legislature	1998	All utilities	RSA 362-A:2 (HB 485)
New Jersey	PV and wind <100 kW	Residential and small commercial	0.1% of peak or $2M annual financial impact	Annualized NEG purchased at avoided cost	Legislature	1999	All utilities	AB 16. Electric Discount and Energy Competition Act
New Mexico	Renewables and cogeneration <10kW	All customer classes	None	NEG credited to next month, or monthly NEG purchased at avoided cost (utility choice)	Public Utility Commission	1999	All utilities	NMPUC Rule 571, 17 NMAC 10.571
New York	Solar residential <10 kW; wind residential < 25 kW; Farm biogas systems <400 kW; Farm wind < 125 kW	Residential; farm systems	0.1% 1996 peak demand	Annualized NEG purchased at avoided cost	Legislature	2002; 1997	All utilities	Laws of New York, 1997, Chapter 399; amended SB 6592 (2002)
North Dakota	Renewables and cogeneration <100 kW	All customer classes	None	Monthly NEG purchased at avoided cost	Public Utility Commission	1991	IOUs only, RECs are not rate-regulated	North Dakota Admin. Code §69-09-07-09
Ohio	Renewables, microturbines, and fuel cells (no limit per system)	All customer classes	1.0% of aggregate customer demand	NEG credited to next month	Legislature	1999	All utilities	S.B. 3 (effective 01/01/01)
Oklahoma	Renewables and cogeneration <100 kW and <25,000 kWh/year	All customer classes	None	Monthly NEG granted to utility	Oklahoma Corporation Commission	1988	All utilities	OCC Order 326195

Appendix C

Summary of State Net Metering Programs

This Table was last updated on 7/12/2004

State	Allowable Technology and Size	Allowable Customer	Statewide Limit	Treatment of Net Excess Generation (NEG)	Authority	Enacted	Scope of Program	Citation/ Reference
Oregon	Solar, wind, fuel cell and hydro <25kW	All customer classes	0.5% of peak demand	Annual NEG granted to low-income programs, credited to customer, or other use determined by Commission	Legislature	1999	All utilities	H.B. 3219 (effective 9/1/99)
Pennsylvania	Renewables and fuel cells <10kW	Residential	None	Monthly NEG granted to utility	Legislature	1998	All utilities	52 PA Code 57.34
Rhode Island	Renewables and fuel cells <25kW	All customer classes	1 MW for Narragansett Electric Company	Annual NEG granted to utilities	Public Utility Commission	1998	Narragansett Electric Company	PUC Order Docket No. 2710
Texas	Renewables only <50kW	All customer classes	None	Monthly NEG purchased at avoided cost	Public Utility Commission	1986	All IOUs and RECs	PUC of Texas, Substantive Rules, §23.66(f)(4)
Vermont	PV, wind, fuel cells <15kW Farm biogas <150 kW	Residential, commercial and agricultural	1% of 1996 peak	Annual NEG granted to utilities	Legislature	1998	All utilities	Sec. 2. 30 V.S.A. §219a; amended Senate Bill 138, 2002
Virginia	Solar, wind and hydro Residential <10 kW Non-residential <500 kW	All customer classes	0.1% of peak of previous year	Annual NEG granted to utilities (power purchase agreement is allowed)	Legislature	1999	All utilities	Virginia Assembly S1269 Approved by both Assembly and Senate 3/15/99; amended SB 651 (2004)
Washington	Solar, wind, fuel cells and hydro <25kW	All customer classes	0.1% of 1996 peak demand	Annual NEG granted to utility	Legislature	1998	All utilities	Title 80 RCW House Bill B2773
Wisconsin	All technologies <20kW	All retail customers	None	Monthly NEG purchased at retail rate for renewables, avoided cost for non-renewables	Public Service Commission	1993	IOUs only, RECs are not rate-regulated	PSCW Order 6690-UR-107
Wyoming	Solar, wind, hydro, and biomass < 25 kW	All customer classes	None	Annual NEG purchased at avoided cost	Legislature	2001	All IOUs, RECs, and munis	HB 195, Feb. 2001, amended SF016 (2003)

Notes:

IOU — Investor-owned utility

GandT — Generation and transmission cooperative

REC — Rural electric cooperative

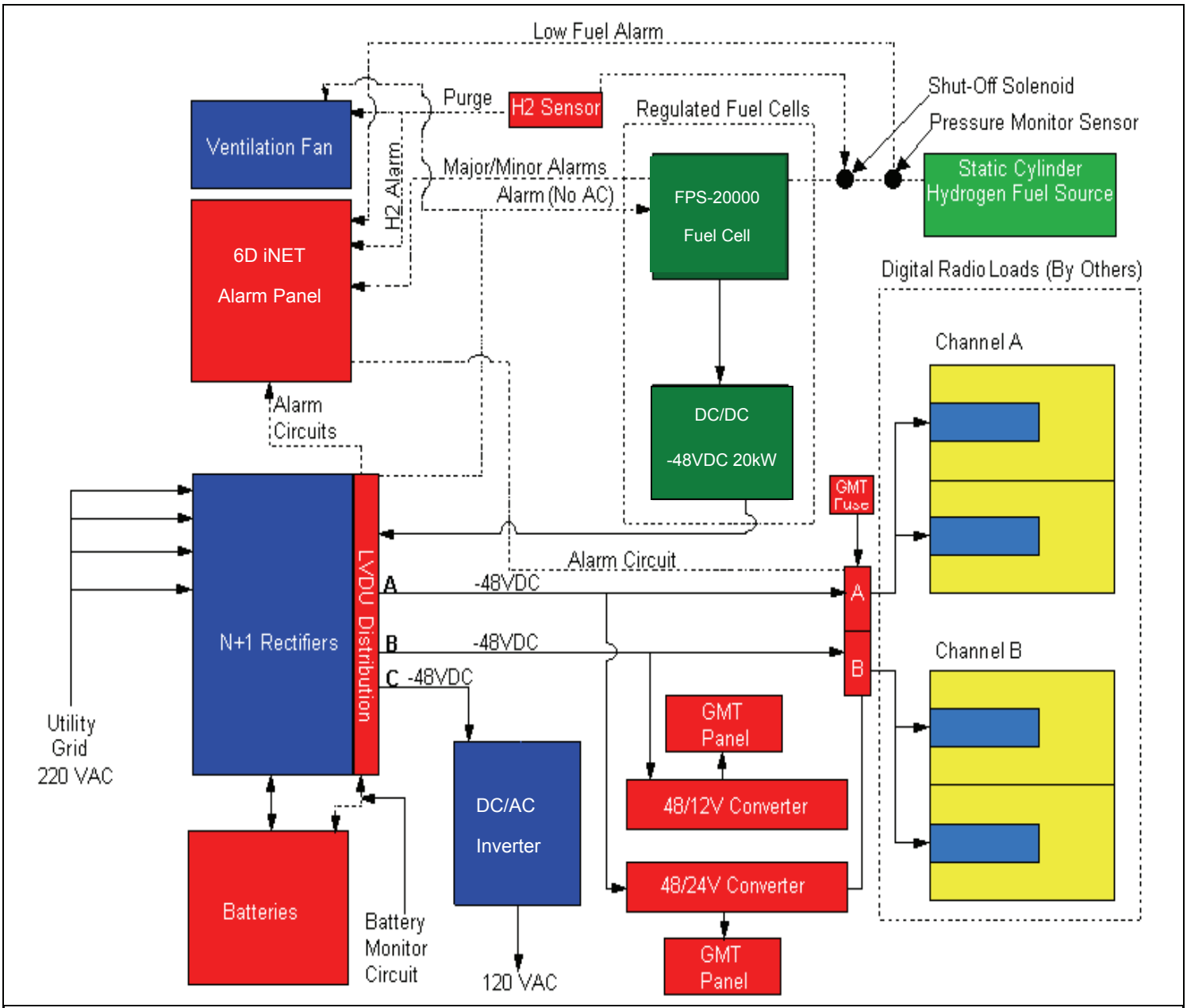
[1] For information, see the Database of Statet Incentive for Renewable Energy (http://

[2] Except for the Linn County Electric Cooperative, which is rate-regulated by Iowa PUC.

The original format for this table is taken from: Thomas J. Starrs (September 1996). *Net Metering: New Opportunities for Home Power. Renewable Energy Policy Project, Issue Brief, No. 2.*

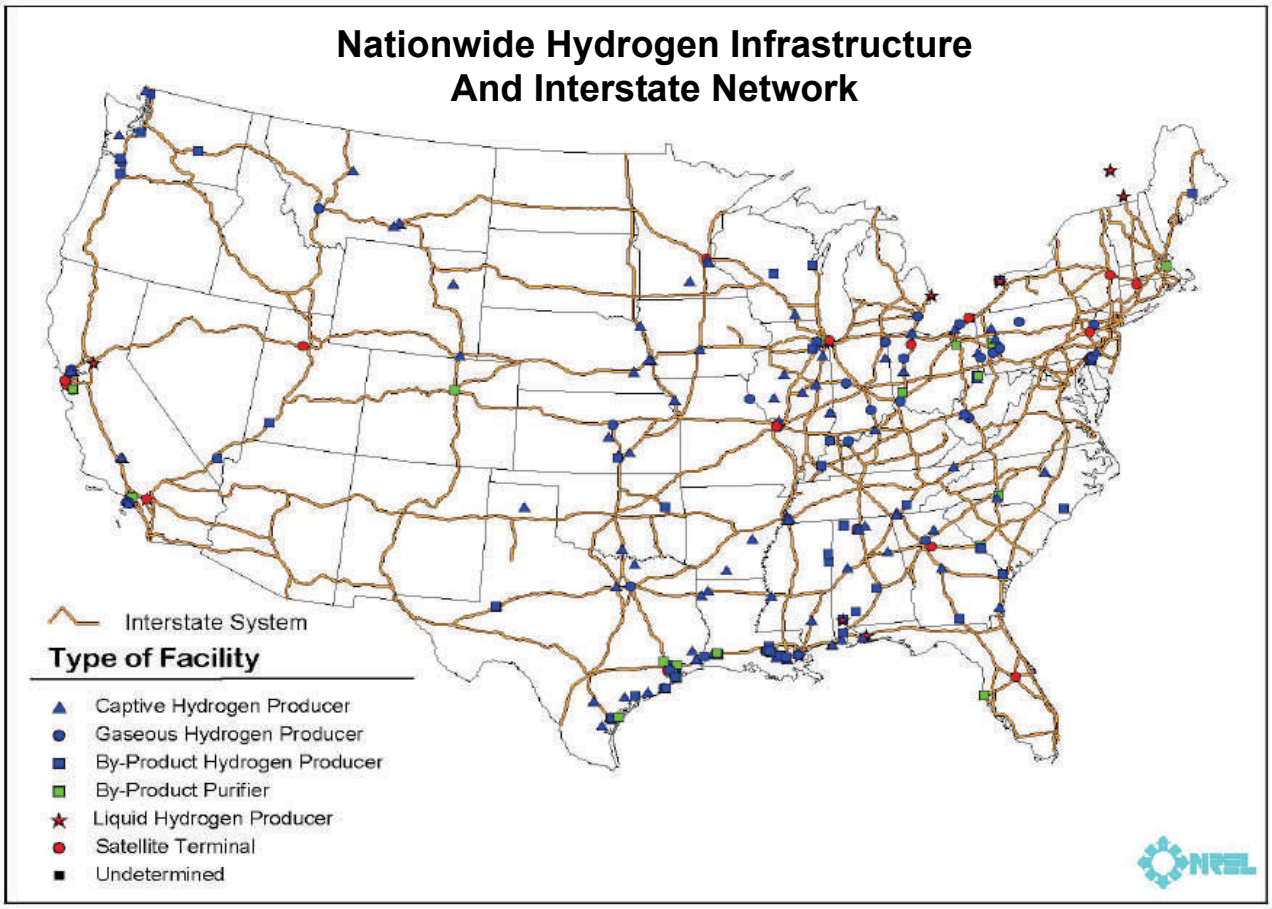
College Park, MD: University of Maryland

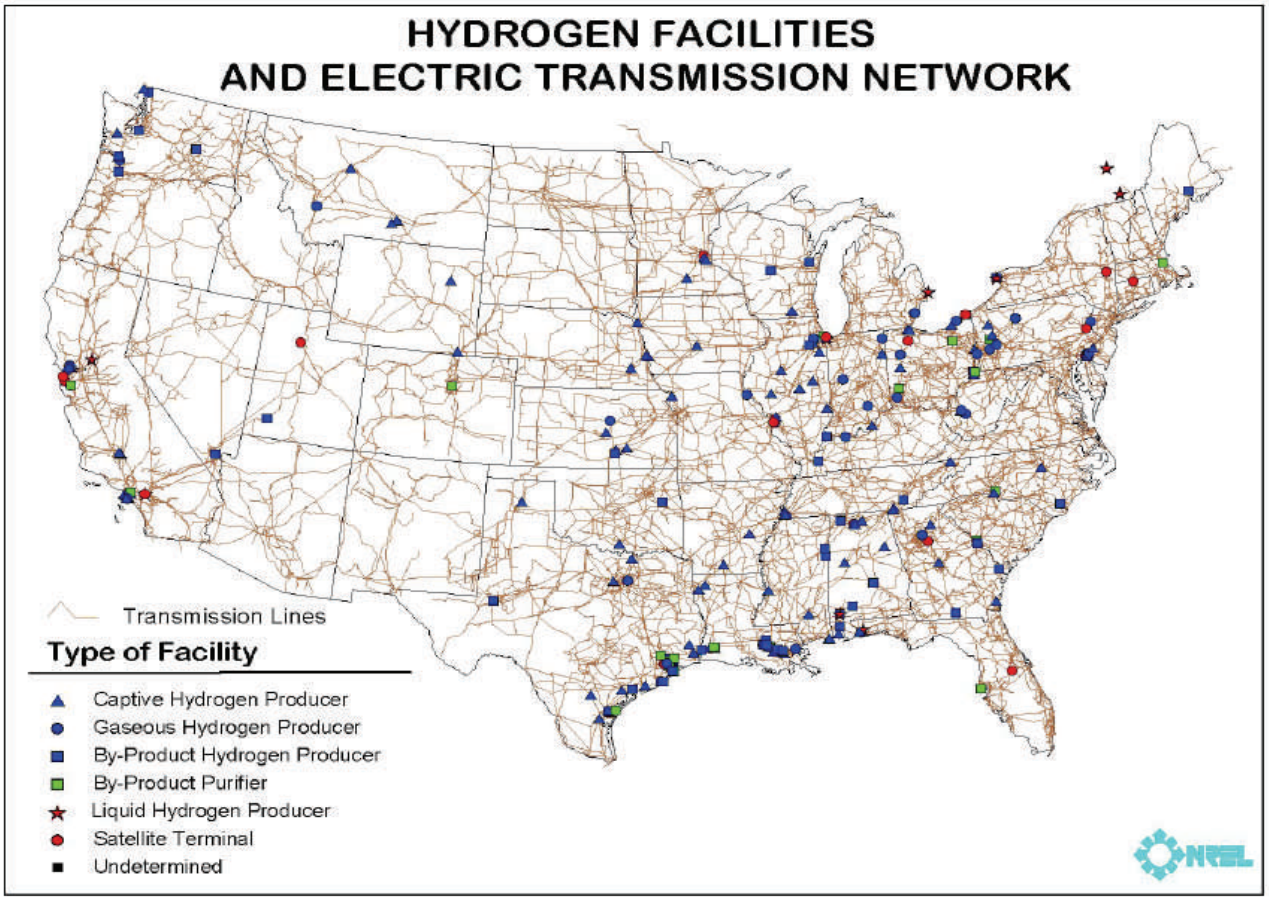
Appendix D



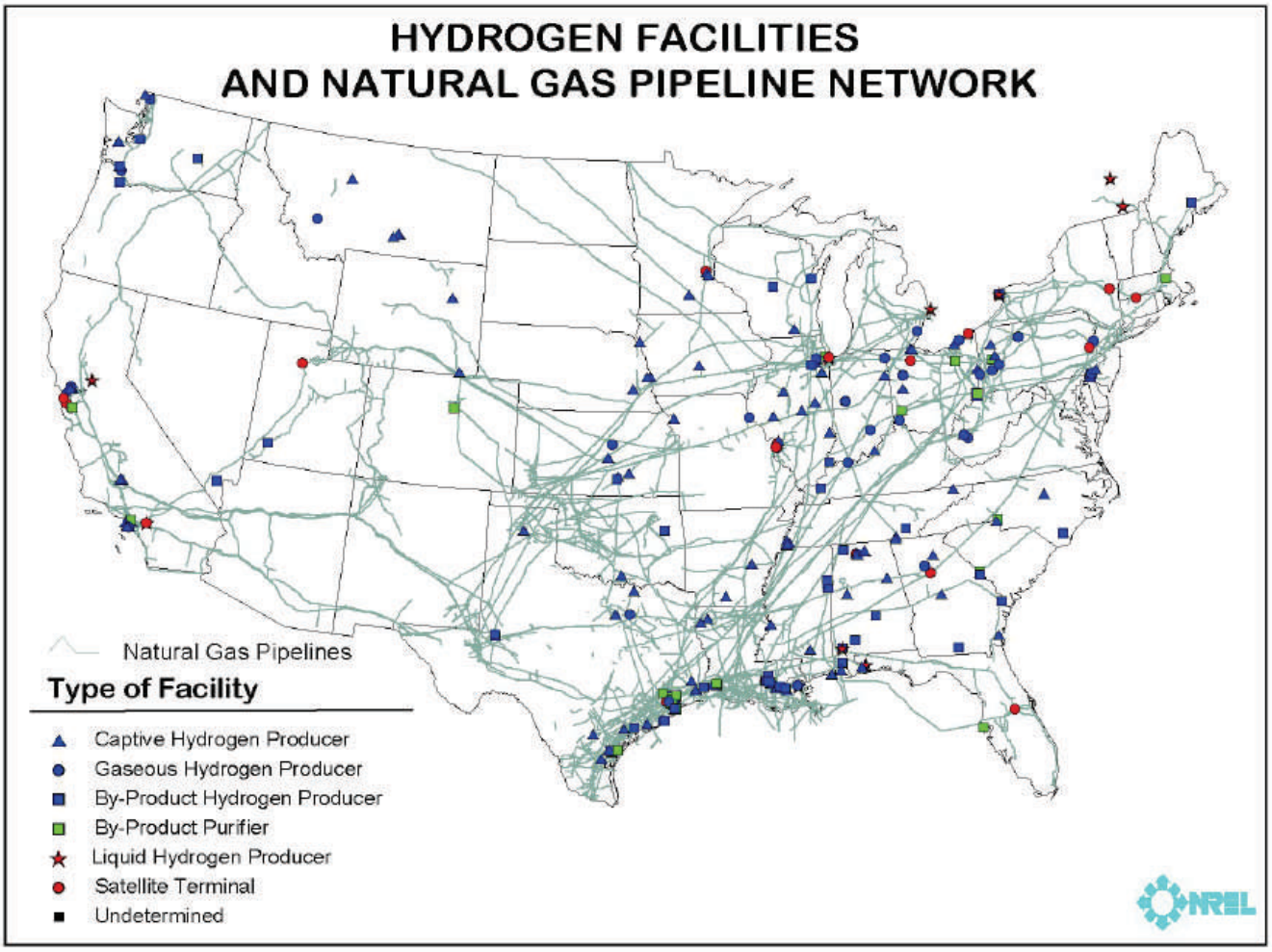
Conceptual Hierarchy of Control for Fuel Cell Powered Cell Tower

Appendix E

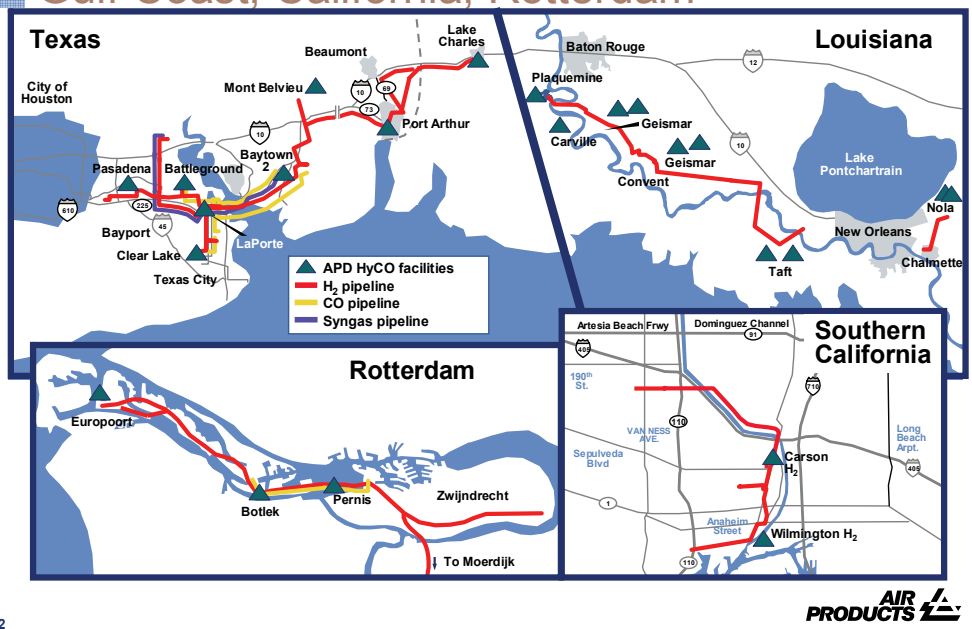

Nationwide Hydrogen Infrastructure
And Interstate Network
Interstate System
Type of Facility
Captive Hydrogen Producer
Gaseous Hydrogen Producer
By-Product Hydrogen Producer
By-Product Purifier
Liquid Hydrogen Producer
Satellite Terminal
Undetermined
NREL


HYDROGEN FACILITIES
AND ELECTRIC TRANSMISSION NETWORK
Transmission Lines
Type of Facility
Captive Hydrogen Producer
Gaseous Hydrogen Producer
By-Product Hydrogen Producer
By-Product Purifier
Liquid Hydrogen Producer
Satellite Terminal
Undetermined
NREL

Appendix E



APD Major Franchise Positions-2004:
Gulf Coast, California, Rotterdam



2

Appendix F

COMPARATIVE THERMAL VALUES	1.00 million Btu	0.0916 million Btu	0.118 million Btu	0.139 million Btu	0.003412 million Btu
Natural Gas 1000 Btu/cu ft	1000 cu ft	91.600 cu ft	118.000 cu ft	139.000 cu ft	3.412 cu ft
Propane 91,600 Btu/gal	10.917 gal	1 gal	1.288 gal	1.517 gal	0.0373 gal
Unleaded Gasoline 118,000 Btu/gal	8.475 gal	0.776 gal	1 gal	1.178 gal	0.0289 gal
Fuel Oil #2 139,000 Btu/gal	7.194 gal	0.659 gal	0.849 gal	1 gal	0.0245 gal
Electricity 3412 btu/kWh	293.083 kWh	26.846 kWh	34.584 kWh	40.739 kWh	1 kWh

Ignition & Explosion Hazards			
Property	Gasoline	Methane	Hydrogen
Density (Kg/M_3)	4.40	0.65	0.084
Diffusion Coefficient in Air (Cm2/Sec)	0.05	0.16	0.610
Specific Heat at Constant Pressure (J/Gk)	1.20	2.22	14.89
Ignition Limits in Air (vol %)	1.0—7.6	5.3—15.0	4.0—75.0
Ignition Energy in Air (Mj)	0.24	0.29	0.02
Ignition Temperature (oC)	228—471	540	585
Flame Temperature in Air (oC) Explosion Energy (G TNT/kj)	2197	1875	2045
Flame Emissivity (%)	0.25	0.19	0.17
Courtesy of Fuelcellstore.com	34—43	25—33	17—25

Energy Values of Hydrogen Equivalent

	Hydrogen	Gasoline	No. 2 Diesel Fuel	Propane	Natural Gas
Higher Heating Value					
Btu/lb	61,002	18,800–20,400	19,200--20,000	21,600	23,600
Btu/kg	134,500	41,500–45,000	42,300--44,100	47,600	52,000
MMJ/kg	141.9	43.8–47.5	44.6--46.5	50.2	54.9
Lower Heating Value					
Btu/lb	51,532	18,000–19,000	18,000--19,000	19,800	21,300
Btu/kg	113,600	39,700–41,900	39,700--41,900	43,700	47,000
MMJ/kg	119.9	41.9–44.2	41.9--44.2	46.1	49.6

Other Fuel Comparisons

Gasoline	1kg	13 kWh	44358 BTU
Methanol	1kg	5.58 kWh	19040 BTU
Propane	1kg	12.9 kWh	44017 BTU
Ethanol	1kg	7.49 kWh	25557 BTU
Butane	1kg	12.7 kWh	43334 BTU
Natural Gas	1kg	13.88 kWh	47361 BTU

Fuel Cell with 50% Efficiency

Fuel Cell Power Output (kW)	Grams H_2/min	Liter H_2/min
1	1	11
5	5	56
10	10	112
15	15	167
20	20	224
50	50	556

Hydrogen Conversions Energy Units of Measure

1 mol of hydrogen = 2.0 grams = 22.4 standard liters

Heat of combustion of hydrogen: 241.8 kilojoules/mol of H_2 (LHV)

115 Btu/gram of H_2

1 kilogram of H_2 = 33.3 kWh = .12 gigajoules

1 standard cubic foot of H_2 = 2.53 grams of H_2 = 28.32 liters of H_2 = .028 cubic meters of H_2

1 cubic meter of hydrogen = 3.0 kWh

1 kW = 1000 watts = 1000 joules/second = .948 Btu/second

1 kW = 1.34 horsepower

Appendix G

Summary of State Incentive and Rebate Programs for Fuel Cells

State	Program	Incentive			Notes
		Max Amt	Limits	Type	
California	SELFGEN Level 1 (renewable)	$4.50/Watt	50%	Rebate	
	SELFGEN Level 2 (non-renewable)	2.50/Watt	40%	Rebate	
	Emerging Renewable Program (renewable)	$3.20/Watt	$400,000	Rebate	decreases $0.20/W every 6 months
Connecticut	Local Option for Property Tax			Exemption	varies by municipality
Delaware	Green Energy Program Grants	250,000	50%	Grant	Delmarva P&L area, Conectiv customers
DC	District of Columbia Renewable Demonstration	180,000	50%	Grant	renewable fuels
Indiana	Distributed Generation Grant Program (DGGP)	30,000	30%	Grant	20kW min, 50% eff
	Alternative Power & Energy Grant Program	30,000	30%	Grant	Renewables only
Kansas	State Energy Program Grants (annual March prop)	50,000		Grant	Renewables only - $ per proposal
Maine	Renewable Resources Matching Fund Program	50,000	50%	Grant	Fuel Cells considered renewables
Maryland	Corp Inc Tax Credit (10 yr fwd) & Sales Tax exemp		30%	Tax Credit	Green Buildings > 20,000 SF
Massachusetts	Commercial, Industrial & Institutional Initiative	$4.00/Watt	50%	Grant	>10kW (+$2/W for renewable)
Michigan	Energy Efficiency Grants	varies		Grant	Case-by-Case evaluation
Montana	Alternative Energy Investment Corportate Tax Credit		35%	Tax Credit	
	Renewable Energy Systems Exemption (Renewable)		$100,000	Exemption	10 Year property tax exemption
Nevada	Renewable Energy/Solar Sales Tax Exemption			Exemption	Sales & Use Tax exemption on equip
New Jersey	New Jersey Clean Energy Program < 10 kW	$5.00/Watt	60%	Rebate	Wind and Biomass 2004 incentive rates
	New Jersey Clean Energy Program > 10 kW	$2.00/Wat	30%	Rebate	$3/W for first 10kW
	Renewable Energy Advanced Power Program		20%	Grant	Renewable fuels, 1MW min (aggregated)
New York	Green Building Tax Credit Program	$1.00/Watt	30%	Tax Credit	Corporate Income Tax Credit
Oregon	Renewable Energy Systems Exemption			Exemption	Property tax exemption
	Business Energy Tax Credit	35% of Cost		Tax Credit	Corporate Tax Credit taken over 5 years
Pennsylvania	Sustainable Energy Funds	varies		Grant	Case-by-Case evaluation
Vermont	Sales Tax Exemption		15kW	Exemption	Sales Tax exemption on equipment
Washington	Sales and Use Tax Exemption			Exemption	Sales & Use Tax exemption on equip
Wyoming	Renewable Energy Sales Tax Exemption			Exemption	Sales Tax exemption on equipment

Notes: 1. Source: DSIRE Database of State Incentives for Renewable Energy (www.dsireusa.org)
2. Updated 2/12/05

Appendix G

Summary of Latest State Renewable Energy Support
Summer 2005

Illinois

State Enacts Voluntary RPS

Acting on a proposal from Governor Rod Blagojevich, the ICC adopted a resolution establishing a Sustainable Energy Plan for the state, which includes portfolio standards for renewable energy and energy efficiency.

The renewable portfolio standard (RPS) calls for 2% of bundled retail load to be obtained from renewable energy resources in 2007, increasing 1% annually until reaching 8% in 2013. Three-quarters of the renewable energy used to meet the RPS should come from wind power and one-quarter from other sources, such as solar and certain biomass resources. The state will not implement a renewable energy credit trading system.

The energy efficiency portfolio standard calls for a 10% reduction in load growth in 2007-2008, 15% reduction in 2009-2011, 20% reduction in 2012-2014, and 25% reduction in 2015-2017.

Both the renewable and energy efficiency standards are voluntary and subject to rate-impact tests. For the RPS, the maximum percentage increase in retail rates is capped at 0.5% in any one year and 2% on a cumulative basis. For the energy efficiency standard, the maximum percentage rate increase is 0.5% per year computed separately for each rate class for which demand response and energy efficiency programs are available, and based on the total annual bill for a typical customer within the class.

ICC Resolution Adopting the Governor's Sustainable Energy Plan:
http://eweb.icc.state.il.us/e-docket/reports/view_file.asp?intIdFile=148072&strC=bd

ICC Staff Report on the Illinois Sustainable Energy Initiative:
http://www.icc.illinois.gov/ec/docs/050713ecEnergyRpt.pdf (PDF 264 KB)

ICC Contact:
Harry Stoller, (217) 785-5278

Iowa

State Agencies to Buy Renewable Energy

Governor Tom Vilsack issued an executive order directing state agencies to obtain 10% of their electricity from renewable energy sources. According to the order, "agencies may generate their own alternative energy or may participate in their utility's green power purchase program, where available, to meet this requirement."

The order also calls for the agencies to reduce their energy consumption by an average of 15% by 2010, relative to 2000 levels, and to procure alternative or hybrid-electric vehicles for 100% of their non-law-enforcement light-duty fleet by 2010. In addition, all state bulk purchases of diesel fuel must contain 5% renewable content by 2007, increasing to 20% by 2010.

Iowa Executive Order 41:
http://www.governor.state.ia.us/legal/41_45/EO_41.pdf (PDF 645 KB)

Maine

Solar Rebate Program Enacted

Governor John Baldacci signed into law a bill to provide rebates for qualifying solar thermal and photovoltaic (PV) systems installed at residences and businesses. PV systems are eligible for a rebate of $3 per watt on the first 2,000 watts of installed capacity and $1 per watt for the next 1,000 watts. Solar thermal systems, for water or space heating, qualify for a rebate of 25% of the system cost or $1,250, whichever is less.

A total of $500,000 will be available each year for the solar rebate program and will be raised through a customer surcharge not to exceed 0.005¢/kWhon electric bills. In each fiscal year, 25% of the fund is to be allotted to PV system rebates and 75% allotted to solar thermal system rebates. The PUC has initiated a rulemaking to develop the rules for the rebate program, which will expire at the end of 2008.

Maine Act to Encourage the Use of Solar Energy:
http://mainegov-images.informe.org/msep/pdf/AnActtoEncouragetheUseofSolarEnergy.pdf (PDF 1.2 MB)

Maine PUC Notice of Proposed Rulemaking for Solar Energy Rebate Program:
http://www.state.me.us/mpuc/staying_informed/news/news_releases/prSolarRebate.htm

PUC Contact:
Denis Bergeron, (207) 287-1366

Massachusetts

State Won't Meet RPS Requirement

The Division of Energy Resources (DOER) issued a report documenting progress toward meeting the state's renewable portfolio standard. Beginning in 2003, all retail electric suppliers were required to obtain at least 1% of their total sales to customers from renewable energy sources, with the requirement increasing in 0.5% annual increments until reaching 4% in 2009.

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The report finds that although all suppliers complied with the law in 2003, there will not be enough renewable energy available to meet the entire requirement of 1.5% of total sales for 2004. Those suppliers that cannot meet the requirement must make alternative compliance payments (ACPs), which are expected to raise $15 million, which will be invested in new renewable energy projects to increase available supplies. The ACP rate for 2004 is $51.41/MWh. The DOER forecasts that the shortfall will be temporary as the premium for renewable electricity fostered by the Massachusetts program and similar programs in other states stimulates investments in new renewable power sources.

Massachusetts Division of Energy Resources RPS Web Page:
http://www.mass.gov/doer/rps/index.htm

DOER Contact:
Chris Goetcheus, (617) 973-8767

Michigan

PSC Approves Net Metering Program

The PSC approved an amended consensus agreement that implements a voluntary statewide net metering program for a minimum of five years.

Under the agreement, net-metered customers will be credited for net excess generation (NEG) at the utility's retail price of generation. Any credits will be carried over from month to month, limited to a 12 billing-month cycle. At the end of each cycle, cumulative NEG credits, if any, may be retained by the utility and the customer's credit reset to zero. The value of any generation credits retained by the utility will be used to offset net metering program costs.

The PSC rejected a provision in the agreement that would have required that ownership of renewable energy certificates associated with a customer's generation be transferred to the utility. Eligible technologies include solar, wind, geothermal, biomass (including waste-to-energy and landfill gas), and hydroelectric (less than 30kW in size). Both residential and business customers are eligible for net metering, subject to an overall limit of 0.1% of the utility's peak demand in the previous year.

Michigan PSC Order Approving Voluntary Statewide Net Metering Program:
http://www.dleg.state.mi.us/mpsc/orders/electric/2005/u-14346_3-29-2005.pdf (PDF 710 KB)

Michigan Renewables Energy Program Web Site:
http://www.michigan.gov/mrep

PSC Contact:
Tom Stanton, (517) 241-6086

Montana

RPS Bill Becomes Law

Governor Brian Schweitzer signed a bill requiring each public utility operating in the state to procure a minimum of 5% of its retail electricity sales from eligible renewable energy sources beginning in 2008, increasing to 10% in 2010, and 15% in 2015 and thereafter. At least 75 MW of capacity must come from community renewable energy projects.

Utilities may use renewable energy credits for RPS compliance, but they may not resell renewable energy credits and count the sold credits toward meeting its RPS obligation, nor may they apply credits sold to customers through a voluntary green power program.

Utilities are required to enter into power-purchase contracts for renewable energy with a minimum duration of 10 years. Also, utilities must pay a penalty of $10 per MWh of shortfall, if they fail to meet the RPS in any year and may not recover the penalty in electricity rates.

Restructured utilities operating in the state are relieved from the RPS obligation if the cost of electricity from an eligible renewable resource—including the cost of ancillary services necessary to manage the transmission grid and firm the resource—is greater than the cost of power available from nonrenewable suppliers. Other utilities are relieved from the RPS obligation if the cost of the renewable resource exceeds the cost of power from other sources by more than 15%.

Montana Bill Creating a Renewable Portfolio Standard (SB 415):
http://data.opi.state.mt.us/bills/2005/billhtml/SB0415.htm

Nevada

Legislature Again Revises RPS Statute

Governor Kenny Guinn signed a bill that revises the state's RPS law by lowering the near-term portfolio requirement but raising the long-term requirement and allowing energy efficiency measures to meet up to one-quarter of the standard in any one year.

The RPS is now set at 6% in 2005 and 2006, increasing by 3% every two years until reaching 20% in 2015 and thereafter. Not less than 5% of the requirement must be met from solar energy systems. To be eligible, energy efficiency measures must be installed at a retail customer's location and the cost must be directly reimbursed, in whole or in part, by the utility.

Separately, the PUC opened a hearing into the failure of the state's two utilities, Nevada Power and Sierra Pacific Power, to meet the 5% minimum RPS requirement for 2004. Sierra Pacific met the non-solar requirement but failed to meet the solar requirement. The state RPS law allows the PUC to exempt the utilities from compliance if

renewable energy supply is insufficient to meet the standard. Both utilities were granted exemptions from meeting the target in 2003.

The two utilities were ordered to develop a compliance plan that outlines achievable goals and milestones, addresses all identifiable barriers, and identifies possible solutions to barriers that may prevent compliance with the RPS.

Nevada Bill Revising the State's Renewable Portfolio Standard (AB 3):
http://leg.state.nv.us/22ndSpecial/bills/AB/AB3_EN.pdf (PDF 80 KB)

Nevada PUC Docket Addressing Utility Compliance with the State's Renewable Portfolio Standard (Docket #05-4003):
http://puc.state.nv.us/electric/dkt_05-4003/05-4003.htm

PUC Contact:
Anne-Marie Bellard, (775) 687-6035

New Jersey

Statewide Green Power Program Okayed

The BPU approved a new voluntary program that will give the state's retail electricity customers the option of signing up for "green power" on their utility bills. Under the statewide program, electric customers will be able to subscribe to the program and select from multiple green power products and marketers without having to switch their supplier.

The New Jersey Green Power Choice Program will be the first statewide program of its kind where multiple utilities and green power marketers will join with the state to give consumers access to the regional market for renewable energy. Each customer who decides to participate in the voluntary program will pay an amount that is determined by their mix of "green power" selected from their power supplier. Green power sold in the program must be sourced from renewable energy that is not otherwise used to meet a statutory requirement, such as a renewable portfolio standard.

The BPU's Office of Clean Energy will oversee and administer the program and ensure that relevant New Jersey consumer-protection rules and procedures are followed. The program will be available later this year after the utility companies make the necessary changes to their billing and information systems.

New Jersey BPU Order Establishing a Statewide Green Power Choice Program:
http://www.bpu.state.nj.us/wwwroot/cleanEnergy/EO05010001_20050413.pdf (PDF 13.6 MB)

New Jersey BPU Order Establishing a Statewide Green Power Choice Program:
http://www.bpu.state.nj.us/wwwroot/cleanEnergy/EO05010001_20050413.pdf (PDF 13.6 MB)

Solar RECs System Operational

The nation's first tracking and trading system for solar renewable energy certificates (SRECs) is now operating in New Jersey. The system tracks and issues SRECs for solar electricity production from "behind-the-meter" distributed generation systems. Each SREC represents one MWh of solar production. Load-serving entities in New Jersey are required to procure a certain percentage of their electricity supply from solar photovoltaics and demonstrate their compliance through participation in the New Jersey SREC Program.

New Jersey Solar Renewable Energy Certificates Web Site:
http://www.njcep.com/srec/

BPU Contact:
Mike Winka, (609) 777-3312

North Dakota

New Laws Promote Wind Energy

Governor John Hoeven signed into law a comprehensive package of legislation designed to accelerate production of wind energy and biofuels, as well as enhance the transmission infrastructure necessary to get both renewable and conventional energy to market.

New legislation creates an Office of Renewable Energy within the Division of Community Services at the North Dakota Commerce Department. The new office will assist in the development of renewable energy within the state and promote energy conservation in both the public and private sectors. The office will administer programs and advance information pertaining to state and federal incentives available for the full range of renewable energy sources.

Among the new laws designed to promote wind energy development are:

- Creation of a North Dakota Transmission Authority, which will promote new and substantial investment in transmission lines in North Dakota. (HB1169)
- A provision to allow the trading of renewable energy credits to other states, which will promote the development of wind energy in North Dakota. (HB1314)
- A provision to raise the jurisdictional threshold for siting electrical power generation facilities from 50 MW to 100 MW, thus reducing the regulatory burden for wind energy companies to site plants in North Dakota. (HB1283)

Appendix G

- A reduction in the assessed value of a wind turbine electric generation unit from 3% to 1.5% to promote the commencement of construction on wind facilities prior to July 1, 2006. (SB2018)

North Dakota Governor's News Release:
http://governor.state.nd.us/media/news-releases/2005/04/050422.html

North Dakota Bill to Provide for the North Dakota Transmission Authority (HB 1169):
http://www.state.nd.us/lr/assembly/59-2005/bill-text/FRAB0300.pdf (PDF 27 KB)

North Dakota Bill to Allow Trading of Renewable Energy Credits (HB 1314):
http://www.state.nd.us/lr/assembly/59-2005/bill-text/FAEK0700.pdf (PDF 8 KB)

North Dakota Bill Relating to Siting of Energy Conversion Facilities (HB 1283):
http://www.state.nd.us/lr/assembly/59-2005/bill-text/FBDD0300.pdf (PDF 6 KB)

North Dakota Bill Creating an Office of Renewable Energy and Energy Efficiency and Addressing the Taxable Valuation of Wind Turbine Electric Generators (SB 2018):
http://www.state.nd.us/lr/assembly/59-2005/bill-text/FQMK0500.pdf (PDF 52 KB)

Texas

State Expands RPS Law

The legislature passed a bill that expands the state's existing RPS from 2,000 additional MW in 2009 to 5,000 additional MW in 2015 (representing about 5% of the state's electricity supply) and sets a target of 10,000 MW of capacity installed by 2025. The bill provides that 500 MW of generating capacity be derived from non-wind renewable sources, such as solar and biomass.

The legislation gives the PUC the authority to order construction of new transmission lines to meet the state renewables goal and to cap the price of renewable energy credits and suspend the RPS goal, if necessary to protect the reliability and operation of the grid. The PUC also will ensure that all renewable energy capacity installed in the state and all renewable energy credits awarded, produced, procured, or sold from renewable capacity in the state are counted toward meeting the RPS goal. Governor Rick Perry is expected to sign the legislation.

Texas Senate Bill 20 Relating to the State's Renewable Energy Goal:
http://www.capitol.state.tx.us/cgi-bin/tlo/textframe.cmd?LEG=79&SESS=1&CHAMBER=S&BILLTYPE=B&BILLSUFFIX=00020&VERSION=3&TYPE=B

Vermont

State Establishes Renewable Energy Goal

Governor James Douglas signed into law a bill establishing a renewable portfolio goal for the state, which, if not met, will become a mandatory renewable portfolio standard in 2013. The law encourages each retail electricity provider to supply an amount of new renewable energy equal to its total incremental energy growth between 2005 and 2012. The amount of new renewable energy that must be supplied is capped at 10% of a provider's total electricity sales in 2005.

New renewable energy is defined as energy from eligible projects placed into service after December 31, 2004. Incremental capacity obtained from existing renewable energy projects also meets the standard. Providers can meet the requirement through eligible new renewable energy credits, new renewable energy resources with renewable energy credits still attached, or a combination of the two. Eligible generating facilities can be located either inside or outside of the state.

The PSB is charged with developing the regulations and procedures necessary to implement the policy, including establishment of a system of tradable renewable energy credits "designed to be consistent with regional practices." The PSB is also charged with ensuring that "providers disclose the types of generation used and whether the energy is Vermont-based, and shall clearly distinguish between energy and tradeable energy credits provided from renewable and non-renewable sources and existing and new sources."

In addition, the PSB is charged with establishing a renewable energy fund that would offer an alternative compliance mechanism for providers to make an as yet unspecified amount per kilowatt-hour payment, in lieu of purchasing tradable renewable energy credits.

Electricity providers can be relieved from the portfolio responsibility if the PSB "determines that compliance with the standard would impair the provider's ability to meet the public's need for energy services . . . at the lowest present value life cycle cost, including environmental and economic costs."

Vermont Act Establishing a Renewable Energy Goal (S 52):
http://www.leg.state.vt.us/docs/legdoc.cfm?URL=/docs/2006/acts/ACT061.HTM

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