Regulation of Power Generated by Stationary Fuel Cells in the United States

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I. INTRODUCTION

The race to commercialize fuel cells in the United States has been ongoing for twenty years now. The interest in their successful commercialization has never been greater than in recent years due to the perception that fuel cells offer significant environmental advantages over conventional power generation at a time when air quality is a problem in many major urban areas. The interest in fuel cells is also due to the perception that a move toward a hydrogen-based economy will allow the United States to wean itself from dependence on foreign oil. This dependence not only creates a significant trade deficit, it also creates a costly and troublesome security problem. To this end, the U.S.

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government and the fuel cell industry have invested hundreds of millions of dollars in developing technology that will compete with conventional power production. However, all of this investment will be of little use unless a regulatory scheme is in place enabling fuel cells to come to market.

Fuel cells are continuous batteries that combine oxygen from the air with hydrogen to make water. In the process, electrons are stripped from the hydrogen atoms, creating a direct current from the electron flow. The critical energy source for fuel cells is hydrogen. Hydrogen is commonly made around the world for use as an industrial gas for industries such as petroleum refining and food processing. Typically, hydrogen is made from natural gas through a process called steam reforming, which is most economically undertaken in a large-scale setting where millions of cubic feet per day are produced. In some places, such as the Louisiana and Texas Gulf Coast, hydrogen manufacturing and transportation infrastructures are in place, but hydrogen has previously been considered too valuable as an industrial gas to be used for power generation. In other places, however, such as where hydrogen is produced as a by-product of chlor-alkali operations, hydrogen is being burned much as natural gas would be. Because this is an inefficient use of hydrogen as a power source, these locations will likely be the first to exploit fuel cells on a large scale.

There are a number of different types of fuel cells, most of which are best suited for stationary power production. One type of fuel cell, which uses a Polymer Exchange Membrane (PEM), an electrolyte, runs at low temperatures and is capable of being turned on and off. Accordingly, PEM fuel cells are being developed for the automobile industry to replace the internal combustion engine, and are being hailed as our best hope for American independence from foreign oil. As a result, considerable research has been undertaken on both the PEM technology and the related hydrogen storage and transportation problems that must be resolved in order for it to become commercially viable.

The higher temperature fuel cell technologies are generally more efficient than PEM cells and produce heat for cogeneration in addition to electricity. However, they are not easily turned on or off, and as a result, are better suited for stationary applications. Two types of these fuel cell technologies are very promising: Solid Oxide and Molten Carbonate. Both promise great efficiencies and cogeneration capabilities, and both are capable of directly reforming hydrogen from natural gas, thus making access to a hydrogen supply less critical. But both technologies are years from being commercially competitive with conventional power generation.

A third stationary fuel cell technology, known as Phosphoric Acid Fuel Cells (PAFC), based on its use of phosphoric acid as an electrolyte, operates at lower temperatures than do Molten Carbonate or Solid Oxide fuel cells. As a result, PAFC does not promise the efficiencies of Solid Oxide and Molten Carbonate. However, PAFC technology is available now and has been proven to be extremely reliable. PAFC technology can be competitive with conventional power generation if inexpensive hydrogen is available, and if there is regulatory law in place to support its use.

This Article discusses the existing regulatory law that governs power generation and considers how these laws affect the commercial viability of stationary fuel cells. Many areas of regulatory law affect fuel cells—most notably those areas governing hydrogen production, storage, and transportation. Other areas of regulation include safety, zoning, permitting, and discharge of effluents (principally water). All of these regulations may significantly affect the ability of companies to bring fuel cells into the market. But for stationary fuel cells, the regulation of power generation is perhaps the most important, and because fuel cells have not been commercially competitive to date, this area of law remains largely undeveloped.

It will be difficult for stationary fuel cells to be competitive with power generation on the large scales typically seen for gas fired, coal, or nuclear power plants until the environmental and security costs of hydrocarbon supply are accounted for. In some instances, credits for reduced nitrous oxide and sulfur oxide emissions are available. However, for the most part, environmental and security costs are unaccounted for by current regulatory schemes in the United States. As a result, the principle regulatory scheme currently relevant to the economics of stationary fuel cells is that scheme that governs distributed power generation in general.

Distributed power generation refers to small-scale power generation from sources off the grid for delivery to locations nearby, usually on site. It ranges from very small scale (e.g., 5 kilowatts (kW)—enough to power a typical house) to larger scales (e.g., 30 megawatts (MW)—enough to power an industrial plant). Use of distributed power generation enables a power producer to avoid waste through transmission losses. More importantly, it enables a power producer to avoid the skyrocketing expenses utilities are experiencing that are associated with acquiring rights-of-way and building new transmission and distribution (T & D) lines. One common example of existing distributed power generation can be found in industrial settings where power needs are great and industrial users often find it more economical to generate their own power on site rather than purchase it from the grid. However, a common future target for distributed power generation is older urban settings. Here, the existing grid is proving insufficient to supply consumers, but the cost of new T & D infrastructure is prohibitive. Where distributed power generation is required, stationary fuel cells are one of several options to supply the power. Other options include diesel power, natural gas turbine, and micro-turbine. Fuel cells can be competitive with other forms of distributed power generation if the regulatory laws of the jurisdiction are compatible with their use.

Once the power is generated, several delivery options are available to the power producer in a distributed setting. The most common option is to consume the power on site. If excess power is produced, the power generator may wish to deliver such power into the grid and collect a fee. However, it is not uncommon for a power producer to want to deliver the electricity to a third party nearby, which may require both interconnection with the grid and transportation by the utility to the site of consumption. This model would be especially applicable to a company using fuel cells to produce the power. Unlike natural gas turbines, which can access natural gas from just about anywhere, sources of cheap hydrogen may not be located near the point of the most profitable sale. Accordingly, a power producer may have to transport the electricity to a nearby market. Each of these scenarios is relevant to fuel cells and is regulated by state and federal governments. This regulatory scheme may affect whether stationary fuel cells become commercially viable.

II. POWER GENERATION REGULATORY LAW AFFECTING STATIONARY FUEL CELLS

A. *Controlling Federal Law*

The Federal Energy Regulatory Commission (FERC) regulates interstate power transportation and distribution. The federal government has not attempted large-scale regulation of intrastate power generation or transportation and distribution. Even though FERC has not ventured into the intrastate power arena, its regulations still affect the manner in which fuel cells are characterized under state laws and regulations. FERC has promulgated regulations relating to small power production and cogeneration.[1] Many states, including Texas, New York, and Connecticut, look to the FERC regulations as the definitive authority for characterizing power plants as "qualifying facilities" that utilize renewable resources.[2] FERC has established two categories for qualifying facilities: the "small power production facility";[3] and the "cogeneration facility."[4] These two qualifications, which are used nationwide by state lawmakers for guidance, should be reviewed and perhaps amended to facilitate fuel cell development on the local and state level. Under current FERC regulatory schemes, a fuel cell manufacturer can fit within the definition of a "small power production facility" only through legal juxtaposition. The "small power production facility" regulations require that the primary energy source, defined as greater than seventy-five percent of the total energy input of the facility, be "biomass, waste, renewable resources, geothermal resources, or any combination thereof."[5] The regulations additionally require that natural gas use be limited to ignition, startup, testing, and other minimal usages.[6] However, hydrogen may or may not be considered a renewable resource. Hydrogen is an input to the electrochemical reaction taking place in a fuel cell. However, under current technology, hydrogen is derived principally from natural gas. By ignoring the primary source of hydrogen (i.e., natural gas) and focusing instead on hydrogen input, a fuel cell should qualify as a "small power production facility."

Most high temperature fuel cells should, on the other hand, be considered a cogeneration facility under FERC regulations. For a fuel cell to be qualified as a cogeneration facility, the fuel cell must meet an efficiency standard of 42.5%.[7] High temperature fuel cells, including PAFC, can provide efficiencies of up to eighty percent in cogeneration settings, which more than adequately meets this regulatory standard. PEM cells, on the other hand, will not likely meet this standard, and indeed are not considered a candidate for cogeneration.

The issues raised in the FERC regulatory scheme for small power production facilities exist because of FERC's limited focus on solar,

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1. 18 C.F.R. §§ 292.101-.602 (2004). The regulations were promulgated under FERC's authority pursuant to the Public Utilities Regulatory Act of 1978 (PURPA). 16 U.S.C. §§ 791a-825r (2000).
2. 18 C.F.R. § 292.204.
3. *Id.* § 292.203(a).
4. *Id.* § 292.203(b).
5. *Id.* § 292.204(b)(1)(i).
6. *Id.* § 292.204(b)(2).
7. *Id.* § 292.202(m).

wind, waste, and geothermal facilities.[8] While FERC exempts such facilities from regulation without limit to size, even when combined to form large power production facilities, a similar "fuel cell farm" which exceeds 80 MW in the aggregate would not be exempted from FERC regulations.

Furthermore, the fuel use criteria necessary to become a "qualifying facility" stall the development of fuel cells. FERC regulations currently require that at least seventy-five percent of fuel input be from biomass, waste, renewable resources, or geothermal resources.[9] While some fuel cells may qualify for this category, most current fuel cell technology utilizes hydrogen reformed from natural gas. Certainly the ultimate goal of fuel cell technology is to qualify as a truly renewable resource. Until the technology develops further, FERC regulations should allow a natural gas exception for fuel cells, even if only for a limited period of time, to allow the technology to develop to a stage where such an exception may no longer be required.

In order to stimulate fuel cell development, FERC cannot sit on the sidelines and allow other federal agencies, such as the Department of Energy, the Department of Defense, the Department of Transportation, the Environmental Protection Agency, and the Department of Agriculture, to fund projects without also reviewing its own narrow regulations. States such as Texas, New York, California, Ohio, and Connecticut are doing their part to stimulate growth in fuel cells. Many states look to the FERC regulations for guidance in determining funding and regulatory exemptions for renewable resources. That being so, FERC could help lead our nation into oil independence by revising its regulations to allow fuel cells that use natural gas to be considered a renewable resource, even if only for a limited period of time.

B. *State Laws Affecting Distributed Generation and Stationary Fuel Cells*

1. Site Selection and Interconnection

In most jurisdictions, site selection and interconnection for generation of power requires approval by the public service commission of that jurisdiction. This is true even when all power will be used internally. For instance, before any power plant may be constructed in Texas, the builder must register with the Public Utilities Commission and

8. *Id.* § 292.204(b); 16 U.S.C. § 796(17)(E) (2002).
9. *Id.*

submit a Certificate of Convenience and Necessity.[10] Any generator of 1 MW or more that is not a power generation company, or any qualifying facility that does not sell or provide electricity to the purchaser of the facility's thermal output, must register as a self-generator.[11] There is a similar application process in New York in which a potential generator of any system with a contractual total aggregate nameplate rating of over 15 kilovolt-amps (kVA) must submit an application to the utility.[12]

States have encouraged distributed power generation by simplifying the regulatory process for obtaining site and interconnection permits. In California, there have been attempts to streamline the process for power plants that cause no significant environmental impact or that are smaller than 50 MW.[13] Until recently there was an 80 MW threshold for applications to construct and operate an electric generating facility in New York, above which the New York State Board on Electric Siting and the Environment must review and approve the permit.[14] Smaller power plants get less scrutiny from the state agencies and are delegated to local zoning boards.[15] The New York Public Service Commission recently revised its rules regarding power production less than 300 kVA, providing a streamlined review process and a more ordered progression for the review of the proposal.[16]

An important feature of the New York plan is its effort to standardize some of the interconnection and balance of plant equipment requirements.[17] Balance of plant is a significant cost attribute of stationary fuel cells, even if you exclude fuel processing (reforming hydrogen from methane) from the definition of balance of plant. The biggest consideration is the converter (sometimes called an "inverter"), which is used to convert direct current (DC) to alternating current (AC) power. For a 500 kW fuel cell, a converter may cost several hundred

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10. 16 TEX. ADMIN. CODE § 25.101(b) (2004).

11. *Id.* § 25.109(a)(2).

12. *See* N.Y. STATE PUB. SERV. COMM'N, N.Y. STATE STANDARDIZED INTERCONNECTION REQUIREMENTS AND APPLICATION PROCESS FOR NEW DISTRIBUTED GENERATORS 300 KVA OR LESS, OR FARM WASTE GENERATORS 400 KW OR LESS, CONNECTED IN PARALLEL WITH RADIAL DISTRIBUTION LINES (Aug. 5, 2003), *available at* http://www.dps.state.ny.us/SIR_Require_08_03.PDF (last modified Dec. 15, 2003).

13. *See* EDISON ELEC. INST., STATE GENERATION & TRANSMISSION SITING DIRECTORY: AGENCIES, CONTACTS, AND REGULATIONS § 1:10, at 9 (2004), *available at* http://www.eei.org/industry_issues/energy_infrastructure/generation/StateGenerationTransmissionGuide.pdf.

14. N.Y. PUB. SERV. LAW § 160 (McKinney 2000) (repealed Jan. 1, 2003).

15. *See* EDISON ELEC. INST., *supra* note 13, at 81; *see also* N.Y. STATE PUB. SERV. COMM'N, *supra* note 12, at 39-44.

16. *See* N.Y. STATE PUB. SERV. COMM'N, *supra* note 12, at 2-6.

17. *Id.* at 6. Balance of plant is the economic concept of harmonizing all plant operations to attain optimal economic performance.

thousand dollars. The costs tend to increase on a per-kilowatt basis for smaller power generation. It is important for fuel cell companies to have standardized requirements so that the balance of plant equipment can be purchased off the shelf, rather than being specially manufactured.

Among the various forms of distributed power generation production, stationary fuel cells have their own peculiar zoning problem. Because hydrogen is a unique fuel source, the manufacturing, storage, and transportation of hydrogen has its own regulatory rules. Local zoning officials, building officials, and fire marshals are not accustomed to having hydrogen or hydrogen storage facilities in commercial and residential areas. Many fears and apprehensions are based upon inaccurate historical accounts of significant hydrogen related events, such as the infamous Hindenburg conflagration. Therefore, local officials, aware of their fiduciary obligations to the citizenry, are often highly critical of hydrogen production plants and storage facilities even on the smallest of scales. This leads many local zoning, building, and fire codes to unreasonably limit or altogether prohibit hydrogen within their jurisdiction. Interestingly, these same regulations do not limit the small-scale storage and use of other highly flammable (and arguably more dangerous) gases such as methane, propane, and butane.

To date, fuel cell manufacturers have not found large-scale resistance to fuel cells on the local community level. This is because the only commercial stationary fuel cells in use today have onboard fuel processing, i.e., the fuel cell includes a built in steam reformer to manufacture hydrogen from natural gas. Consequently, the existence of hydrogen at the fuel cell site is limited and short-lived.

Unfortunately, onboard fuel processing is cost-prohibitive and has limited the general use of that particular fuel cell technology to niche markets. To reduce the cost of fuel processing, and to bring fuel cells to market more quickly, hydrogen manufacturing must be undertaken in large-scale quantities. This is the current practice for industrial hydrogen plants. Such plants are located far from dense residential regions in areas zoned for industrial use. One cannot casually locate a large-scale hydrogen plant in a commercial or residential area. Accordingly, we might expect early adoption of stationary fuel cells in locations zoned for industrial use that can accommodate short-distance hydrogen transport via pipeline or short-hauler trailers. This has the advantage of available hydrogen infrastructure and large-scale power consumption, and also reduces the problems associated with the public's general misapprehension as to the dangers of hydrogen. Until fuel cells are in common use and people become comfortable with hydrogen in their neighborhood, local communities will likely resist locating hydrogen manufacturing and storage facilities in residential and commercial areas. There is, however, one significant disadvantage to stationary fuel cells in industrial settings: industrial consumers generally expect to pay lower prices for power than residential or commercial consumers pay. This makes reducing the cost of power from fuel cells to competitive levels particularly challenging.

2. Use of Power on Site

The biggest problem associated with distributed power generation that is consumed directly on site is that utilities incur T & D costs in bringing power to a particular location. Abandonment of the infrastructure built to carry that power could lead to a hardship for the utility. Utilities would like to first be able to recoup their costs in building the infrastructure before the distributed power generation facility is brought online. Recoupment of these costs is known as "exit" or "abandonment" fees.[18] Most jurisdictions have regulatory laws that set forth either abandonment rates or procedures for determining the rates. Of course, there is considerable dispute as to what the actual costs of abandonment are, and how the utility may account for these. Utilities tend to take an aggressive approach in calculating abandonment fees. However, aggressive abandonment fees have negative consequences for stationary fuel cells and distributed power generation in general.

Utilities are particularly concerned with the size of the abandonment. It stands to reason that smaller scale abandonment is less of a concern because the recoupment costs are lower. But utilities have a more important concern: there is no real threat of distributed power generation becoming commonplace on the very small scale. Costs of generating power in small quantities are generally not competitive with the grid, and likely will not be in the near future. However, this is not necessarily so in the multimegawatt distributed power generation range, especially for industrial users for whom the cost of power is a significant part of the cost of doing business. Utilities currently have billions of dollars tied up in T & D and are skittish about embracing a technology that might render those assets obsolete. Distributed power generation in the multimegawatt ranges—the most logical pathway for early adoption of stationary fuel cells—is a real threat to the utilities' profits. It is not

18. More information on exit and abandonment fees can be found in Energy and Environmental Analysis, Inc.'s report titled, *Small Electric Generators Utility "Exit Fees"* (2004), *at* http://www.eea-inc.com/rrdb/DGRegProject/ExitFees.html (last modified Oct. 18, 2004).

surprising, then, that the utilities lobby hard to protect their assets when regulations setting abandonment rates are promulgated.

California has promulgated rules governing abandonment, set forth in the California Public Utility Code (CPUC), which attempt to set a threshold for abandonment according to system size. In California, systems smaller than 1 MW are deemed eligible under the CPUC rules and are exempt from exit fee surcharges.[19] Texas, however, is less generous to the utilities; it allows for utilities to recover "non-mitigatable stranded costs" incurred in purchasing power and providing electric generation service from any distributed generator producing more than 10 MW of electricity.[20] Stranded costs in Texas are determined by a proceeding before the Texas Public Utility Commission, which attempts to set actual costs of the assets using a number of factors. These factors include the sale of company stock and arms' length sales of similar assets.[21] In most instances, a fuel cell project developer will need to know what these numbers are before undertaking any project of 10 MW or greater.[22] Presumably, some of the risk of an unpredictable result from the proceeding can be mitigated by negotiating an exit fee with the utility before submitting an application to the Commission.

These minimum thresholds for exit fees are particularly relevant to bringing stationary fuel cells to market today. Currently, the cost of generating hydrogen is such that it is very difficult to provide stationary fuel cells with rates that are competitive with other distributed power generation sources unless the hydrogen is either produced in large amounts or is a by-product of some other operation. It will be difficult to bring fuel cells to market if a hydrogen plant is built to supply a fuel cell that is less than 1 MW. As a result, California's regulatory laws, at least insofar as exit fees go, are not friendly to fuel cells.

On the other hand, a 10 MW exemption, as applies in Texas, is probably sufficient to encourage fuel cell commercialization. The hydrogen supply required for a 5 to 10 MW fuel cell is in the range of millions of cubic feet per day, which is comparable to what is typically found in today's more economical industrial hydrogen plants. Of course,

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19. CAL. PUB. UTIL. CODE § 2827 (Deering Supp. 2004). The decision to exempt "ultra clean" technologies under 1 MW from exit and standby fees also included reciprocating engines and micro-turbine generators which compete directly with stationary fuel cell applications. *See* CAL. STATIONARY FUEL CELL COLLABORATIVE, WHITE PAPER SUMMARY OF INTERVIEWS WITH STATIONARY FUEL CELL MFR. (Aug. 2003), *available at* http://www.stationaryfuelcells.org/DOCUMENTS/PDFdocs/IndustrySurveyReport2004.pdf.

20. TEX. UTIL. CODE ANN. § 39.252(b) (Vernon Supp. 2004).

21. *Id.* § 39.262(h).

22. *Id.*

exemption from exit fees up to 30 MW would be even better. However, utilities will likely resist that threshold; no doubt 10 MW is painful enough.

The requirement that consumers be provided with backup power in case of failure or in times when power usage exceeds the capacity of the distributed power generation facility creates another significant regulatory issue relating to distributed power consumed on-site. Utilities incur T & D expenses for providing backup or incremental power just as they would in providing primary power.[23] Accordingly, utilities seek to recoup their costs in providing such infrastructure in the form of a "standby charge." Standby charges can kill the economics of distributed power generation just as easily as exit fees. In New York, the Public Service Commission is currently developing standby rates for consumers using distributed power generation.[24] The Commission has determined that standby rates will be applicable to residential and commercial customers.[25] However the Commission may make exceptions, on a case-by-case basis, for renewable power or fuel cells.[26]

Fuel cells provide a unique advantage over other types of distributed power generation with regard to standby charges. For many uses, no standby power is required. This is because fuel cells produce what is known as "premium power," meaning the power flow is regular and uninterrupted, with virtually no downtime. Indeed, reliability is one of the chief advantages of fuel cells. Downtime can be engineered to occur at designated times if necessary. The most common downtime occurs when the hydrogen supply is interrupted, and that can be predicted. That predictability allows consumers to go without back up power in many instances. Where there is zero tolerance for power interruption, such as may be necessary at municipal water pumping stations, standby power may still be required.

3. Sale of Power to the Grid

Most distributed power generation producers design plants to have all power consumed on site. However, there are instances where a producer might want to produce more than it can consume, such as

23. Although such costs should be lower because most consumers can get by with less power during emergencies.

24. *See* Order Directing Modifications to Standby Serv. Tariffs, Case 02-E-0551 et al., (N.Y. Pub. Serv. Comm'n Jan. 23, 2004), *available at* http://www3.dps.state.ny.us/pscweb/WebFileRoom.nsf/Web/B6EBBFCB3732B19285256E35006C9B77/$File/doc14323.pdf?OpenElement.

25. *Id.* at 3.

26. *Id.* at 5.

instances of fluctuating power needs. Likewise, the power needs of a distributed power generation producer may change, and the producer may find itself with excess capacity. In such instances, the producer will want to sell its excess power to a market. In the case of fuel cells, where the economics of hydrogen manufacturing suggest that the near-term commercial opportunities are likely to be in the multimegawatt range, it is especially likely that sales back to the grid will be desirable.

A number of jurisdictions are looking at ways to accomplish this. Some states have enabled sales back to the grid through "net-metering." Net-metering is a process by which power flows back into the grid and the producer is credited with a value for that power against its own consumption from the grid.[27] Typically, the producer can choose between a "bi-directional" meter, i.e., one that simply moves in reverse during the time power is delivered to the grid, or a second meter that measures the flow of power into the grid. However producers are not actually given a "kW for kW" credit for power delivered back into the grid. The utility only gives a credit for its own avoided cost of power generation. Alternatively, the utility may charge a standby rate while the power is being delivered to the grid. As a result, a utility may deliver a kW-hour to a consumer/generator for, say eight cents, but buy the same amount of power back from that same consumer/generator for two cents. This is an understandable practice, since the utility bears the cost of transporting the power on both ends. Nonetheless, it frustrates the distributed power generation producer. In most instances, the utility arbitrarily sets its own avoided cost of generation based upon what it considers fair, and it is difficult to contest the utility's numbers. As a result, distributed generation power sold into the grid must compete with the utility's inexpensive (and dirty) large-scale power generation, regardless of the actual value of the power delivered into the grid. Selling power back into the grid is generally not a profitable use of distributed generation power, but is rather an offset to losses that would otherwise occur when power demand on site is low. However those offsets could be important to the economics of distributed power generation, especially for stationary fuel cells, which cannot be shut down during low demand and restarted during high demand.

Unfortunately, many jurisdictions follow the FERC rules and do not allow for net-metering of fuel cells. For instance, New York only applies net-metering rules to photovoltaic and biomass power production. Texas on the other hand, does not appear to make a distinction. Texas requires

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27. CAL. PUB. UTIL. CODE § 2827(b)(3) (Deering Supp. 2004).

that utilities purchase power from any qualifying facility with a design capacity of over 100 kW at a rate that is determined by "avoided costs."[28] If the facility is designed to produce less than 100 kW, then the utility may set its own rate, but the rate must be "fair."[29] Utilities must consider the aggregate capacity value provided by multiple qualifying facilities in deciding whether to use the commission rate or its own rate. This could be a particularly important consideration for fuel cells, since it would otherwise be unclear under the rules whether each individual cell would be considered a facility. Since multiple individual cells are typically aggregated, the aggregate capacity value would determine the rate. As in most states, municipal-owned utilities in Texas are exempt from the commission's net-metering regulations.[30] However, municipalities have voluntarily engaged in the practice of net-metering, at least for renewables. In San Antonio, for instance, the municipal utility pays between 1.65 to 2.02 cents/kW-hr for power delivered to the grid, depending on the season.[31]

In 2002, California expanded net-metering requirements to provide net-metering for any facility up to 1 MW, and to include large industrial and commercial producers.[32] Fuel cells are eligible for net-metering if they are below 1 MW, located adjacent to the customer's premises, and if they are interconnected parallel to the grid.[33] One of the key issues for net-metering in California relates to who pays for the cost of studying the interconnection. Utilities have argued that larger scale facilities sending power into the grid require considerable expense in studying the impact on the distribution system, along with other interconnection expenses. Accordingly, they would like to see the producer bear these costs.[34] Distributed generators, on the other hand, would like to be exempt from interconnection study costs and distribution modification fees.[35] Because early adoption of fuel cells will likely be in the multimegawatt scale, this issue will need to be resolved in California.

Uniform interconnection is an important issue for fuel cell power sales to the grid. Both California and Texas publish guidebooks for

28. 16 TEX. ADMIN. CODE § 25.242(f) (2004).
29. *Id.* § 25.242(h)(4).
30. *Id.*
31. IREC Interconnection Project, State Net Metering Programs 4 (Apr. 18, 2003), *at* http://www.irecusa.org/articles/static/1/binaries/Net_metering_table_4_18_03.pdf.
32. CAL. PUB. UTIL. CODE § 2827.
33. *Id.* § 2827.10.
34. Opinion Interpreting Pub. Util. Code Section 2827(d), Draft Decision of A.L.J. Cooke (Mar. 21, 2002), *available at* http://www.cpuc.ca.gov/word_pdf/COMMENT_DECISION/13371.pdf.
35. *Id.*

interconnection rules.[36] California Rule 21 covers distributed power generation below 10 MW, with simplified rules for below 10 kW. Under Rule 21, the utility does not approve or disapprove a design, but rather determines if the design complies with requirements.[37] In addition to complying with Rule 21, interconnections must also comply with local, state, and national codes, such as the National Electric Code and the Uniform Building Code. Technical requirements for interconnection include voltage fluctuation, flicker, harmonics, and DC injection.[38]

A utility can obtain certification for interconnection by having an independent testing laboratory run a series of tests. It is useful to get the interconnection preapproved, and the California Energy Commission has preapproved several fuel cell interconnections.[39] Under the current California rules, a generator first fills out an application.[40] Then, the utility affected by the sale reviews it, and decides if it is sufficient or if further study is needed.[41] If more study is needed, the utility passes the cost through to the applicant.[42] If the generator accepts the results of the utility's review, then an interconnection agreement is executed, and the applicant installs the generator and the interconnect equipment.[43]

Texas has promulgated a set of uniform interconnection standards applicable to all utilities, except those owned by municipalities or co-operatives. It has created the Electric Reliability Council of Texas (ERCOT) to ensure nondiscriminatory access to transmission and distribution systems in that state.[44] The technical rules for interconnection can be found in the Distributed Generation Manual; however, there are no requirements peculiar to fuel cells in the manual.[45]

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36. CHRIS COOLEY ET AL., CAL. ENERGY COMM'N, CONSULTANT REPORT: CALIFORNIA INTERCONNECTION GUIDEBOOK: A GUIDE TO INTERCONNECTING CUSTOMER-OWNED ELECTRIC GENERATION EQUIPMENT TO THE ELECTRIC UTILITY DISTRIBUTION SYSTEM USING CALIFORNIA'S ELECTRIC RULE 21 (Sept. 2003), *available at* http://www.energy.ca.gov/reports/2003-11-13_500-03-083F.PDF [hereinafter RULE 21]; DISTRIBUTED UTIL. ASSOCS. & ENDECON ENG'G, PUB. UTIL. COMM'N OF TEX., DISTRIBUTED GENERATION INTERCONNECTION MANUAL (May 1, 2002), *available at* http://www.puc.state.tx.us/electric/business/dg/dgmanual.pdf.

37. RULE 21, *supra* note 36, at 13-14.

38. *See id.*

39. *Id.* at 17-18. For types of approved equipment, see CAL. ENERGY COMM'N, CALIFORNIA DISTRIBUTED ENERGY RESOURCE GUIDE, *available at* http://www.energy.ca.gov/distgen/interconnection/certification.html (last modified Feb. 6, 2004).

40. *Id.* at 24.

41. *Id.* at 38.

42. *Id.* at 47.

43. *Id.* at 55.

44. 16 TEX. ADMIN. CODE § 25.361 (2004).

45. DISTRIBUTED UTIL. ASSOCS. & ENDECON ENG'G, *supra* note 36, § 5.3.

4. Sales to Third Parties

Existing hydrogen infrastructure presents an attractive opportunity for early adoption of fuel cells. However, the location of the excess hydrogen may not coincide with the location of the best markets for the power. A power producer has two options: it may either transport the hydrogen (most likely by pipeline) to the fuel cell, which is located at the site of the power market; or, it may locate the fuel cell at the site of the excess hydrogen, and transport the power from the fuel cell to the market. Of the two, the latter is more financially attractive in most circumstances.

As we have already seen, until external costs are accounted for, sale of power to the grid will generally not be an attractive option, except as a way to cut losses during times of low demand. A better option would be to sell the power to a consumer nearby, preferably one paying very high rates for power purchased from the grid. However, the power producer will generally need to engage the utility to deliver the power to the consumer—even over short distances. Of course, these are not consumers that the utilities are wild about losing, and so the utility will not have a great deal of motivation to make it easy for distributed generators to engage in third party sales.

In California, power from a generator connected to the distribution system may only be sold to a utility (i.e., net-metered), unless one applies for a FERC wholesale tariff and signs a Wholesale Distribution Access Tariff agreement with the utility.[46] Accordingly, there is no longer "direct access" that allows one private party to sell power to another private party through the grid.[47] It may be that the tariff under FERC rules will be sufficiently economical that it will support the first use of stationary fuel cells in California. It would be a good place to start: California has a well-established hydrogen infrastructure and a terrific market for power. Add to this the government's concern for air quality and the value of by-product water generated from fuel cells, and it seems like an ideal situation. In order for this to happen in California, an enterprising fuel cell company or independent power producer must find excess hydrogen located near high-end industrial consumer markets, and apply for the Wholesale Distribution Access Tariff to determine if it makes economical sense.

46. COOLEY ET AL., *supra* note 36, at 10.
47. *Id.*

III. STRATEGIES FOR ENABLING COMMERCIAL SUCCESS OF STATIONARY FUEL CELLS

The Gulf Coast and California are particularly well situated to be the leaders in stationary fuel cell commercialization because an established hydrogen infrastructure already exists. Among the Gulf Coast states, Texas in particular is a likely place for early adoption. The Texas Commission on Environmental Quality has named several large Texas cities, including Dallas and Houston, as "non-attainment airsheds," effectively restricting the building of new power plants in and around those cities.[48] The emission-free nature of fuel cells makes the economics of fuel cells particularly attractive to the Houston area, especially when combined with the relatively inexpensive hydrogen available in that region. In Houston the environmental benefits of fuel cells are apparent, and as a result, Houston will likely be one of the first markets to adopt stationary fuel cells.

In addition to accounting for the environmental benefits of fuel cells, Texas is also considering the economic and environmental effects of the distance over which power is transmitted. The proposed change is being considered because large amounts of power are being produced in rural areas (e.g., in West Texas wind farms) and being transmitted long distances to urban areas, leading to costly transmission congestion. This change would benefit distributed power generation in general by reflecting the actual cost of T & D in the price paid for power from the grid. For stationary fuel cell applications, this could also make a difference in the economics of a fuel cell located at an existing hydrogen facility with excess capacity. The lower T & D costs associated with the short transportation of power from that location to a nearby consumer would be reflected in a lower price paid.

California and Texas are by no means the only states working toward enabling stationary fuel cell commercialization. Other states, such as Massachusetts, specifically treat fuel cells as a renewable energy source for purposes of "buy down" programs. Under these programs, the government contributes to the cost of acquisition of the generator, even though fuel cells require hydrogen to be reformed from natural gas.[49] New York has invested millions of dollars in fuel cell development,

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48. Memorandum from Dale Beebe Farrow, P.E., Director, Air Permits Division, Texas Commission of Environmental Quality, to all Affected Parties (June 18, 2004) *at* http://www.tnrcc .state.tx.us/permitting/airperm/nsr_permits/files/8hr_memo.pdf) (last visited Oct. 31, 2004).

49. Methane from landfills or other renewable sources are future sources of hydrogen, but these sources are not likely to be among the early sources of hydrogen because of the large scale production needed to reduce costs.

including hosting a 200 kW phosphoric acid fuel demonstration run from reformed bio-gas to a wastewater treatment facility in Yonkers.[50]

Similarly, Ohio has a $100 million "Third Frontier" program designed to enable Ohio companies that manufacture fuel cells or their parts to become commercially successful. This program includes several million dollars in grants awarded for demonstrations of fuel cell technology.[51] Connecticut, Michigan, and Pennsylvania have also provided substantial state government support for the fuel cell industry in the form of grants, loans, tax breaks, and other similar incentives.[52]

However, funding from these states is more a function of the state's concerns about job creation and the potentially disruptive effect a change to the hydrogen economy would have on the work force. In short, these states are more worried about jobs than clean energy. The midwestern and eastern seaboard states still have a great deal of work to do to develop regulatory laws that will enable fuel cells to significantly penetrate the power market.

There are near-term markets available for stationary fuel cells where power prices are high, grid congestion is a problem, and air quality is a problem. Municipal water supply and sewage treatment facilities also continue to be good targets for stationary fuel cells. But until environmental and security externalities are addressed, fuel cells will struggle to compete with traditional "dirty" power from the grid. Fuel cells would not have to compete with the grid to be successful if there was a regulatory code in place that promoted distributed generation and fuel cells. Once these regulations are developed, beginning with the Federal Energy Regulatory Code, there will be ample opportunities available to ensure the commercial success of fuel cell technology.

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50. Paul Morini, CHP Opportunities at New York State Wastewater Treatment Plants, DISTRIBUTED ENERGY, July/Aug. 2004, *at* http://www.distributedenergy.com/de_0407_chp.html.

51. OHIO DEP'T OF DEV., OHIO'S FUEL CELL ROADMAP, at i (2004), *available at* http://www.thirdfrontier.com/documents/OhiosFCRoadmapRpt-FINAL_000.pdf.

52. CONN. GEN. STAT. § 12-412(113) (2004); MICH. COMP. LAWS § 207.822 (2003); PA. CONS. STAT. ANN. § 8701-B (West 2000).