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Minnesota Department of Commerce

DEVELOPING THE HYDROGEN ECONOMY IN MINNESOTA: Creating Jobs and Economic Development Through Minnesota-Based Renewable Hydrogen Resources

A Report to the State Legislature
Pursuant to Minn. Laws, Chapter 11, Article 2, Section 19

January 16, 2004

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EXECUTIVE SUMMARY

The 2003 Minnesota Legislature directed the Department of Employment and Economic Development (DEED) to: (1) develop a targeted program to promote and encourage the development and attraction of businesses engaged in hydrogen and fuel cell technology; (2) develop a plan to designate not more than three energy innovation zones to spur the development of hydrogen, fuel cells and renewable energy technologies in the state.

There are many applications for hydrogen fuel cells. The first area poised to gain a significant market share will most likely be micro fuel cells for use in cell phones and laptop computers. The second market entry is expected to be stationary applications that provide backup power or main power to small commercial facilities. However, due to high installation costs, main power supply units have yet to gain market acceptance – while backup power units are gaining market share for use in data protection. Finally, mobile power for use in the transportation industry may eventually prove to hold the greatest market potential for hydrogen fuel cells. However, this application faces many hurdles, including the development of a support infrastructure to make the fuel cells economically viable.

Drivers of the fuel cell industry include: loss of energy dollars for net energy importing states like Minnesota; lack of access to the electric grid; energy security; concerns about oil supplies; benefits to consumers; and the environment.

Barriers to the fuel cell industry include: high capital cost; lack of uniform codes and standards; interconnection costs and related issues; lack of an infrastructure; durability; and lack of education and training.

The Department of Employment and Economic Development (DEED) in partnership with the state Department of Commerce held focus group meetings to discuss issues surrounding the development of the hydrogen and fuel cell industries in Minnesota. The focus groups were made up of 27 participants representing the fuel cell industry, electric utilities, private consultants, higher education, state agencies and nonprofit organizations.

The majority of the participants did not favor the idea of an *Energy Innovation Zone* but rather supported the idea of funding for Energy Innovation Projects. The forms in which hydrogen is found and stored (water, organic matter, etc.), plus distribution system costs, make it necessary that hydrogen production occur near its source.

Therefore, production in the state cannot be confined to a small number of facilities in central locations. Rather, it must occur throughout the state to fully take advantage of Minnesota-based renewable energy resources.

Minnesota's strength in renewable energy resources like wind, biomass and solar power gives the state a competitive advantage since hydrogen can be extracted from all three. According to one conservative estimate, about 25 percent of Minnesota's total energy consumption can be met by current technology using agricultural crop residues. In the near term, Minnesota will benefit from the development of its renewable resources, while waiting for the long-term development of hydrogen and fuel cell technologies. Both near-term and long-term strategies will promote economic development by keeping energy dollars in the state.

Currently, 29 states have some type of program, initiative or incentive for hydrogen and/or fuel cells. These programs include renewable portfolio standards, renewable energy purchasing, production incentives, construction policies, loan and grant programs, property tax incentives, state rebates, personal income tax incentives, corporate tax incentives, and industry recruitment programs.

Public Benefit Funds are another mechanism utilized to support the hydrogen, fuel cell, and renewable energy industries. The funds are developed through the electric utility restructuring process to fund renewable energy projects, energy efficiency initiatives, and low-income support programs.

Any program designed to develop a hydrogen production industry in the state of Minnesota should include the entire state to take advantage of its renewable resources, create jobs and economic growth, and leverage additional funding.

Based on the criteria listed above, studies of efforts in other states, and with the input of the focus group participants, DEED – with support from the Department of Commerce – has developed the following recommendations for a targeted program to attract businesses in the hydrogen, fuel cell, and renewable energy industries:

1. Funding for individual Energy Innovation Projects (EIP) rather than Energy Innovation Zones should be the primary vehicle for developing this industry. Minnesota's strength lies with its renewable resource base, and EIP are a more appropriate tool for developing the industry. To reflect the change in the program's focus, the language in Minnesota Session Laws 2003, 1st Special Session, Chapter 11 should be changed from "Energy Innovation Zones" to "Energy Innovation Projects."

2. Establish a statewide program to fund Energy Innovation Projects and research. The criteria for approving projects should include a provision that all funded EIP have a direct economic benefit to the state of Minnesota. A review board that will evaluate the merits of projects and determine funding should administer the program.

3. In order for Minnesota to develop its hydrogen and fuel cell industry, additional investments should be considered. During the emerging stage, development of the industry is influenced by technological opportunities created by government intervention. Technological opportunities that fit within the state's science base frequently lead to the first businesses in that industry.

4. The Department of Employment and Economic Development together with the Department of Commerce should develop a ***Hydrogen and Fuel Cell Resource Guide*** that provides contacts and resources for those seeking potential partners, experts, development locations, Internet sites, programs and applicable federal, state and local policies, incentives, and funding.

5. Partnerships between industry and higher education are needed to guide public research toward technologies and engineering solutions that have commercial potential. The state should develop an industry/university collaborative program directed towards the commercialization of renewable hydrogen and fuel cells. The Legislature should formally recognize the Minnesota Renewable Hydrogen Initiative. Minnesota should also pursue strategic partnerships with neighboring states to develop renewable energy and hydrogen-based energy systems if such partnerships offer promising opportunities for the state.

6. Minnesota should develop a program to educate the public about the benefits of hydrogen and renewable energy through demonstration projects and a concerted public relations campaign. The state, in partnership with MNSCU, the University of Minnesota and its K-12 school districts should develop programs to train the next generation of scientists, engineers and technicians in the knowledge and skills necessary to install, operate, maintain, and develop these new energy technologies.

7. Minnesota should make fuel cells eligible for net metering rules and consider increasing the limit on system size. The state should develop codes and standards and help reduce local government barriers to facilitate the development of these new technologies and their implementation.

INTRODUCTION

In his 2002 State of the Union Address, President George W. Bush identified hydrogen as a long-term energy solution for the United States and the world. Hydrogen has the potential to reduce dependence upon foreign oil and reduce greenhouse gas emissions, while promoting economic growth and providing energy security. It is impossible to separate renewable energy from a discussion about hydrogen. More than 95 percent of the hydrogen that is produced today is made by reforming natural gas. In the future, much of the hydrogen production may come from renewable resources, including electrolysis of water, wind energy and biocatalysis of plant material. According to the U.S. Department of Energy, an estimated 30.9 billion kilowatt hours of electricity could be produced annually from biomass fuels in Minnesota, or 180 percent of residential electricity use.[1] Transportation costs are such that hydrogen must be produced in close proximity to where the resource is found. For example, once the distance for shipping biomass reaches about 25 miles, it becomes cost prohibitive to use that resource. Therefore, any plan to encourage the development of a hydrogen production industry in Minnesota must occur throughout the state and concentrate on the development of a renewable energy infrastructure.

The 2003 Minnesota Legislature directed the Minnesota Department of Employment and Economic Development (DEED) to:

- Develop a targeted program to promote and encourage the development and attraction of businesses engaged in the biocatalysis of agricultural and forestry plant products for the production of hydrogen; the manufacture of hydrogen fuel cells; and hydrogen electrolysis from renewable energy sources.

- Develop a plan to designate not more than three energy innovation zones to spur development of fuel cells, fuel cell components, hydrogen infrastructure and other energy efficiency and renewable energy technologies in the state.

The exact language and details of the legislation are included in Appendix A.

In response to the above legislation, DEED, in partnership with the Minnesota Department of Commerce (DOC), held industry focus group meetings with representatives from the fuel cell component companies, electric utilities, private consultants, higher education, state agencies and nonprofit organizations. The list of participants in the two-day meetings is included in Appendix B. The objective of these focus group meetings was to discuss issues surrounding the development of the hydrogen and fuel cell industries in Minnesota and to develop plans as directed by the 2003 Legislature. A copy of the invitation signed by DEED Commissioner Matt Kramer and DOC Deputy Commissioner Edward Garvey is shown in Appendix C. A list of questions from the focus groups can be found in Appendix D.

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[1] U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. *Minnesota Bioenergy Resources.* Retrieved from www.eere.energy.gov/state_energy/tech_biomass.cfm?state=MN.

MINNESOTA'S RENEWABLE RESOURCE BASE

A focus on Minnesota's renewable resources (biomass, wind, solar power) is crucial to the development of the renewable hydrogen production and fuel cell industries in Minnesota. Utilizing the state's renewable resource base for the production of electricity and biofuels will help stop the flow of energy dollars out of the state. The percentage of Minnesota's energy coming from renewable sources has risen from 4.1 percent in 1990 to 6.1 percent in 1999.[2] The state should not neglect the near-term renewable technologies in favor of long-term fuel cell and hydrogen technologies. Both are important and should be included to create a balanced portfolio that will lead to industry and job growth.

One of the focus group participants pointed out that it is now possible to replace 400 trillion BTUs – about 25 percent of Minnesota's total energy consumption – with agricultural crop residues.[3] The use of biomass resources at the community level to produce energy and other products is currently feasible. Co-products from barley, soybeans and corn can be used for energy production.

Using current technology and local biomass resources to generate energy (e.g., steam) at a competitive, firm contract price at strategic locations can provide an incentive for out-of-state companies to locate in Minnesota. This in turn will promote economic development in the state and the creation of jobs.

A researcher at the University of Minnesota proposed that while the fuel cell is being developed, hydrogen derived from the state's renewable resources can be: (1) burned directly as fuel in boilers; (2) burned in a gas turbine to provide both electricity and heat in rural communities; (3) reformed or extracted from biodiesel; (4) produced through the gasification of wood waste to yield about 50 percent hydrogen.

STATE OF THE FUEL CELL INDUSTRY TODAY

There are several different applications for hydrogen fuel cells. These include:

Micro Power – Likely to be the first commercially competitive fuel cells sometime in 2004-2005, micro applications replace or complement batteries in small applications such as cell phones, laptop computers, digital video recorders and other small electronic devices. Unlike other applications, micro power fuel cells have an immediate competitive advantage over existing technologies. Batteries have become as efficient as they will ever be. With portable

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[2] Energy Information Administration retrieved from www.mnplan.state.mn.us/mm/indicator.html?Id=56.

[3] Investigations with farmers using current harvest techniques suggest a feasible yield is an average of 2.5 tons per acre on 6.5 million acres of corn per year in Minnesota. At 13 million Btu per ton, this represents an energy potential of 211.3 trillion Btu per year. Whole plant harvest techniques now being developed are expected to increase the yield to 5 tons per acre per year and would produce 422.5 trillion Btu, equivalent to about 25% of Minnesota's energy consumption. This is a conservative estimate since it is limited only to corn crops.

devices becoming more powerful and demanding longer energy curves, micro fuel cells can fill an immediate need in the marketplace at a competitive price.

Stationary Power – There are two main applications within this group; backup power supply units and main power supply units. Right now there is a greater market potential for backup power systems to supply companies who need to protect data storage. Minnesota is a leader in data storage systems and these firms could be encouraged to incorporate fuel cell technology in their product offerings. Backup power will most likely be the second-quickest segment of the fuel cell industry to mature and gain market share. The application of fuel cell technology as a main power source is most likely to be applied to small commercial business facilities, but currently the cost is prohibitive for widespread use.

Mobile Power – Mobile power for the transportation industry may eventually prove to be the largest market for fuel cells. Mobile power also faces the greatest challenges. The U.S. transportation sector is 96.65 percent dependent on petroleum.[4] Hydrogen and fuel cells could eliminate most, if not all, of this dependency. However, the development of a support infrastructure to make mobile power feasible is not fully understood. Most industry experts think that the fuel cell car will attain significant market penetration in the next couple of decades. Starting in 2008, auto manufacturers must ensure that 10 percent of new cars meet California's "zero emissions" law. If they do not, they could risk heavy penalties or possibly be prohibited from selling in that state, which is the world's fifth-largest economy.[5] The focus group suggested that implementation of small demonstration projects using fleet vehicles such as transit buses would be a good place to make initial state investments in fuel cell technology.

DRIVERS THAT CREATE MARKET DEMAND

Loss of Energy Dollars – According to the U.S. Department of Energy, Minnesotans spent more than $12 billion on energy in the year 2000, with about 92 percent of those energy dollars leaving the state.[6] Once these dollars have been spent on importing energy into the state, they are not available to foster additional economic output in Minnesota. Because every dollar spent on energy imports is a dollar lost from the local economy, such expenditures represent a substantial loss to local businesses in terms of income and jobs.

Benefits to Consumers – Fuel cells have the advantage of portability. In the very near future, a person will be able to go anywhere on the planet with a laptop computer and have access to the Internet for extended periods of time. With net metering laws, consumers can produce their own electricity and sell excess power back to the power grid, thereby lowering utility bills.

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[4] Energy Information Administration. *Transportation Sector Statistics.* Retrieved from www.eia.doe.gov.
[5] "Fuel Cells: A New Kind of Gas Station", The Economist, December 6, 2003, p. 59.
[6] Energy Information Administration. *State Energy Data 2000, Table 1. Energy Price and Expenditure Estimates by Source, Selected Years 1970-2000, Minnesota.*

Energy Security and Oil Supply – The recent Northeast blackouts have produced a sense of insecurity about reliance on centralized power systems. People are no longer secure in the thought that the lights will always turn on when they flip the switch. The decentralized options afforded by renewable energy sources, fuel cells and hydrogen being available at the local regions, are becoming increasingly attractive.

Two sources, *Oil and Gas Journal* and *World Oil*, estimate world oil reserves at around 1 trillion barrels.[7] Current world oil demand is 79.7 million barrels a day or just more than 29 billion barrels a year. According to the Energy Information Administration, world oil demand is projected to grow to 119 million barrels per day by 2025, an increase of about 2 percent per year over current demand.[8] The majority of studies indicate that world oil production will peak between 2010 and 2020, with some studies estimating a peak within the next six years.[9] Once production has peaked, with demand continuing to grow, oil prices will climb steadily without falling.

U.S. reliance on foreign oil, especially on supplies from the Middle East, is a major concern today. Energy importing states like Minnesota have a choice: reliance on foreign oil or energy independence through the development of local renewable resources.

Lack of Access to the Electric Grid – There are areas in rural Minnesota where it is difficult and/or costly to access the electrical grid. In cases where the areas are also rich in renewable energy resources, utilizing these resources to produce energy at a competitive price makes a lot of sense.

Environment – The consumption of energy in the form of fossil fuel combustion is the largest single contributor of greenhouse gases in the world, accounting for 98 percent of U.S. emissions and 80 percent of world emissions. Fuel cells use an electrochemical process to convert hydrogen into electricity without combustion. Thus, an important driver that will create market demand in Minnesota is the promise of a cleaner environment absent the pollution caused by the combustion of fossil fuels.

BARRIERS TO COMMERCIALIZATION

Cost – Cost is a major factor in the development of both fuel cells and a hydrogen infrastructure. The capital cost of a fuel cell today is about $4,000 per kilowatt. To be competitive, experts estimate that the cost needs to drop to $1,200 per kilowatt for premium backup power applications and $400 per kilowatt for

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[7] Energy Information Administration, *World Crude Oil and Natural Gas Reserves, January 1, 2002.* Retrieved on December 5, 2003 from www.eia.doe.gov/emeu/iea/table81.html.

[8] Energy Information Administration, *International Energy Outlook 2003*. Retrieved on December 5, 2003 from www.eia.doe.gov/oiaf/ieo/oil.html.

[9] Deffeyes, Kenneth S. Hubbert's Peak. New Jersey: Princeton University Press. 2001.

widespread commercial viability. There are two main reasons for the high capital costs. The first is economy of scale. Without mass production, costs will remain high. The second is material cost. The most common catalytic material used in fuel cells today is platinum. As of late December 2003, platinum was trading at $816 per ounce.

Codes and Standards – One of the focus group participants stressed that a common fuel cell standard is needed for the technology to be widely commercialized and accepted. Without the uniform standard, the necessary production volumes required to attain economies of scale will be difficult to accomplish.

Interconnection Costs and Related Issues – Interconnection costs might be too high in certain areas of the state, creating a barrier for the adoption of renewable technologies. Interconnection standards are crucial to the development of distributed energy projects. Regulatory barriers at the state and local levels need to be resolved for these technologies to move forward.

Education and Training – Since fuel cells are new technologies, there is a need for a work force of scientists, engineers and technicians with suitable expertise to develop and maintain the technology. Trained technicians are needed for fuel cell installation, operation and maintenance and scientists will be needed to continue to advance the technology. As the fuel cell industry grows, the emergence of fuel cell technicians needed to service and maintain fuel cells will represent a significant indirect economic impact of the industry in terms of new jobs and income in the state.

In a broader sense, education is needed to increase the public's familiarity and comfort with fuel cells. Compared to Europe and Japan, the U.S. public is behind in its knowledge about fuel cells and their role as a future energy source. Only through education will the public follow the learning curve and widely accept these new technologies.

One of the focus group participants is involved in developing an education curriculum for elementary school children that will increase awareness of hydrogen and fuel cells.

Lack of Infrastructure – Preliminary studies have been conducted to estimate the number of refueling stations needed initially to support fuel cell vehicles throughout the country. Results indicate that between 4,500 and 17,700 hydrogen stations would be required to support fuel cell vehicles.[10] Oil companies estimate that 30 percent of refueling stations in a given area must have hydrogen capabilities for fuel cell vehicles to become acceptable to consumers.[11] Today there are about 180,000 gas stations in the United States. By comparison, there are six hydrogen-refueling stations in the United States and fewer than 100 in the world. Three conditions summarize what has been called the chicken and egg dilemma in regard to fuel cell vehicles:

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[10] Milaina, Marc W. "Initiating hydrogen infrastructures: preliminary analysis", International Journal of Hydrogen Energy 28 (2003): 743-755.

[11] Ball, Jeffrey, Wall Street Journal, "Green dream" March 3, 2003. Retrieved on October 23, 2003 from www.proquest.umi.com/pdqweb?index=4&didi=000003022361351

1. Customers will not purchase fuel cell vehicles unless adequate fueling is available.
2. Manufacturers will not produce vehicles that people will not buy.
3. Fuel providers will not install hydrogen stations for vehicles and customers that do not exist.

The California Fuel Cell Partnership estimated that average fueling station capital costs to be $450,000 per station for low-volume, dedicated single-dispenser vehicle facilities.[12] Based on the average of that estimate, 10,000 stations would cost $4.5 billion. Hydrogen pipelines may also need to be built in many areas. Estimates place the costs of a hydrogen pipeline between $300,000 and $1.4 million per mile.[13] By comparison, natural gas pipelines cost between $200,000 and $800,000 per mile. The total costs of deploying a reliable hydrogen infrastructure on par with current gasoline networks are estimated at a minimum of $100 billion.[14]

Another infrastructure issue is hydrogen storage. Extensive research and development efforts are being conducted to develop economically viable solutions to this problem.

Durability – Passenger vehicles require fuel cells that can operate for 5,000 hours before failure occurs. The transit bus market requires at least a 10,000-hour operational life. Stationary power needs devices that can run for more than 40,000 hours. According to industry experts, however, most fuel stacks currently fail between 1,000 and 2,000 hours, with the leading manufacturers pushing the 5,000 hour mark.[15]

SURVEY OF STATE INCENTIVES FOR HYDROGEN AND FUEL CELL INDUSTRIES

State government must play a role in the development of renewable resources, hydrogen and fuel cell technologies. One way of priming the pump in the marketplace is to provide financial incentives in the form of low-interest loans, tax credits, state bonding, and similar tools. Currently, 29 states have some type of program, initiative, or incentive for hydrogen and/or fuel cells. The different types of incentives with examples are outlined below. A full list of state incentives is shown in Appendix E.

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[12] Energy Independence Now, *How much will Hydrogen infrastructure cost?* Retrieved from www.energyindependencenow.com .

[13] Fuel Cell Today, *Automotive Hydrogen Infrastructure- On the way to a Hydrogen Economy*. Retrieved on October 23, 2003 from www.fuelcelltoday.com.

[14] The Mckinsey Quarterly, Summer 2002 p40, Tomorrows Cars, today's engines. Ealey, Lance and Mercer, Glenn

[15] Northeast Advanced Vehicle Consortium. *Wheels II: A Survey on the Future of Transportation Fuel Cells and Fuel Cell Infrastructure.* Retrieved from www.navc.org.

1. **Renewable Portfolio Standards** – A Renewable Portfolio Standards (RPS) requires that a certain percentage of a utility's overall or new generating capacity or energy sales must be derived from renewable resources. Eight states have renewable portfolio standards with a fuel cell or hydrogen component.[16] A state-by-state breakdown of the standards follows:

STATE	STANDARD
California	20 percent by 2017
Connecticut	10 percent by 2010
Hawaii	9 percent by 2010
Maine	30 percent (In effect now)
Massachusetts	4 percent by 2009, 1 percent increase each year after 2009
New Jersey	6.5 percent by 2009
New Mexico	10 percent by 2011
Wisconsin	2.2 percent by 2010

   Minnesota has a Renewable Energy Objective (REO) to generate or procure 10 percent of the electricity it provides to retail customer from qualifying renewable technologies by the year 2015. A REO differs from an RPS in that it demands a good-faith effort on the part of the utilities to meet the objective while a RSP includes binding enforcement.

2. **Renewable Energy Purchasing** – Executive Order 111, signed by New York Governor George Pataki in 2001, commits New York state government to purchase at least 10 percent of its electric power from renewable energy sources such as wind, solar thermal, photovoltaics, sustainably managed biomass, tidal, geothermal, methane waste, and fuel cells by 2005.

3. **Production Incentives** – The Rhode Island State Energy Office has at least $1.25 million available to support eligible new renewable projects located in New England which serve Rhode Island customers. Eligible technologies include fuel cells (fueled by renewable and non-renewable fuels), landfill gas, wind power, solar energy, hydropower (less than 100 megawatts does not require the construction of new dams) and biomass powered microturbines. The production incentive is 3 cents per kilowatt-hour.

4. **Construction Policy** – Building codes may offer states an opportunity to incorporate renewable energy and efficiency standards in new buildings. Currently, Texas is the only state that utilizes this policy for fuel cells. If the use of alternative energy devices for a particular function is determined to be economically feasible for new and reconstructed state government buildings, the commission or governing body is required to include the use of alternative energy devices for that function in the construction plans.

[16] Database of State Incentives for Renewable Energy. Retrieved from http://www.dsireusa.org/

5. **Loan Programs** – Four states make low-interest commercial loans available to finance the startup and expansion of manufacturers, distributors and installers of advanced clean energy technologies. Pennsylvania has made at least $47 million available for grants. California offers below-market rate loans to manufacturing companies that use the loan to purchase and install of renewable energy systems, energy-efficient equipment, or clean distributed generation systems on their own facilities. Companies can receive up to $40 million for projects.

   Ohio residents and businesses that borrow money to implement energy efficiency or renewable energy projects are eligible to receive loans of up to $25,000 for residents and $500,000 for businesses at interest rates roughly half the market rate. Over $12 million has been committed to energy efficiency projects, primarily for the rental property sector.

6. **Grant Programs** – States offer a variety of grant programs to encourage the use and development of renewable energy technologies. Illinois, Indiana, Kansas, Massachusetts, Michigan, New York, Ohio, Pennsylvania, and Rhode Island offer grant programs. Michigan offers grants to support energy efficiency projects, including fuel cell installations, through the state's Low-Income and Energy Efficiency Fund. Total fund revenue will amount to approximately $240 million over six years. The New York State Energy Research and Development Authority currently has $10 million in funding to support Power Systems, Distributed Generation, and Combined Heat and Power. In Ohio, $25 million is designated for research, development & demonstration grants. In 2003, seven projects in 2003 were awarded a total of $6.4 million.

7. **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 $1,000 for a conventional heating system, then the renewable energy system is assessed at $1,000.

   Oregon is the only state to use property taxes as an incentive for fuel cells. Oregon's property tax exemption states that the added value to any property from the installation of a qualifying renewable energy system not be included in the assessment of the property's value for property tax purposes.

8. **Industrial Recruitment Incentives** – Industrial Recruitment Incentives 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. 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.

Michigan has the most comprehensive company recruitment package today. Companies located in Michigan's NextEnergy Zone and engaged in the research, development, or in the production of alternative energy sources are eligible for numerous tax benefits. The NextEnergy Zone, located at Wayne State University Research and Technology Park in the city of Detroit, will be the home to the NextEnergy Center. The 40,000-square-foot center will be the catalyst of the NextEnergy initiative. It will include laboratory facilities, business incubator space, collaborative meeting space and other facilities that will support the alternative energy industry.

Qualified companies are eligible for a property tax exemption on all alternative energy equipment. Certified companies are exempt through 2012. The sum of state income taxes paid by a company's employees (who work in the Zone) is refunded to the company. This credit is effective through 2022. In addition, qualified companies are exempt from certain state and local taxes, including personal property taxes, real property taxes, and the state's education tax. These exemptions are effective through 2022.

Arkansas established a state income tax credit of 50 percent of the amount spent to purchase or construct a facility that designs, develops or produces fuel cells. The cost can include land, infrastructure, renovation, building improvements, and machinery.

In 2001, Hawaii became the only state in the nation to offer a 100 percent tax credit on an equity investment in a qualified high tech business (QHTB). A "qualified high tech business" is defined as "a business that conducts more than fifty per cent of its activities in qualified research." "Qualified research" includes "non-fossil fuel energy-related technology," which is defined as "energy produced by wind, solar energy, hydropower, geothermal resources, ocean thermal energy conversion, wave energy, hydrogen, fuel cells, landfill gas, waste to energy, biomass including municipal solid waste, and biofuels."

9. **State Rebates** – California's Self-Generation Program (*SELFGEN*) provides incentives to encourage customers to produce energy using microturbines, small gas turbines, wind turbines, photovoltaics, fuel cells, and internal combustion engines. The incentives include payments of $1 - $4.50 per watt, depending on the technology used, and will be funded through the end of 2007.

10. **Personal Income Tax Incentives** –Seven states (Georgia, Kansas, Massachusetts, Maryland, Montana, Oregon, and Utah) offer personal income tax credits or deductions to cover the expense of purchasing and installing renewable energy equipment. Several states offer tax credits of up to $5000 for the purchase of a new low-emission vehicle or zero-emission vehicle. Montana offers an income tax credit for equipment and labor costs incurred to convert a motor vehicle to operate on alternative fuel.

Maryland offers an income tax credit of 30 percent of the costs, including installation, for a fuel cell. The credit applies to nonresidential and residential multifamily buildings of at least 20,000 square feet that are constructed or rehabilitated to meet criteria set by the US Green Building Council.

Massachusetts offers both corporate and personal income tax deductions for any income received from the sale of or royalty income from a patent that is deemed beneficial for energy conservation or alternative energy development. This deduction may be used for five years after it is granted.

11. **Sales Tax Incentives** – Wyoming, Maryland, Vermont and Washington provide 100 percent sales tax exemptions on fuel cell purchases. Nevada exempts fuel cell purchases from local sales taxes. Customers are only required to pay 2 percent state sales tax.

12. **Corporate Tax Incentives** – Corporate tax incentives allow corporations to receive credits or deductions against the cost of equipment or installation to promote renewable energy equipment. Seven states -- Georgia, Kansas, Massachusetts, Maryland, Michigan, Montana, and New York -- have corporate tax incentives to promote fuel cells and hydrogen.

    Kansas allows an income tax credit of up to $200,000 for the construction of an alternative-fuel fueling station.[17]

NET METERING

Net metering allows for the flow of electricity both to and from customers with electricity generating units 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, thereby reducing their utility bills. Fourteen states- Arkansas, Connecticut, Georgia, Idaho, Louisiana, Maine, Massachusetts, Montana, New Mexico, Ohio, Rhode Island, Utah, Vermont, Washington- make fuel cells eligible for net metering rules. Most states limit eligible system sizes to 100 kW or less. California has the largest limit on system size at 1 MW. Minnesota has a limit of 40 kW. Fuel cells are not eligible for net metering in Minnesota.

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[17] "Alternative fuel" is defined by 42 U.S.C. 13211, which states: "Alternative fuel" means methanol, denatured ethanol, and other alcohols; mixtures containing 85 percent or more (or such other percentage, but not less than 70 percent, as determined by the Secretary, by rule, to provide for requirements relating to cold start, safety, or vehicle functions) by volume of methanol, denatured ethanol, and other alcohols with gasoline or other fuels; natural gas; liquefied petroleum gas; ***hydrogen***; coal-derived liquid fuels; fuels (other than alcohol) derived from biological materials; electricity (including electricity from solar energy); and any other fuel the Secretary determines, by rule, is substantially not petroleum and would yield substantial energy security benefits and substantial environmental benefits.

PUBLIC BENEFIT FUNDS

Public Benefit Funds are typically state-level programs developed through the electric utility restructuring process to fund renewable energy projects, energy efficiency initiatives, and low-income support programs. Public Benefit Funds are typically funded through a charge to all customers on electricity consumption, e.g., 0.3 cents/kWh. Of the fifteen states that have a public benefits fund, six -- California, Connecticut, Maine, Massachusetts, New Jersey, and Wisconsin -- also have renewable portfolio standards.

California created a $540 million fund for renewable energy in 1996. An additional $1.35 billion was added in 2000 to fund the program through 2012. The California Energy Commission manages the fund through four separate accounts:

1. Existing technologies – 45 percent
2. New technologies- 30 percent
3. Emerging technologies- 10 percent
4. Consumer side account- 15 percent

The Connecticut Clean Energy Fund will generate $118 million over five years through a charge to electric customers. The fund is managed by Connecticut Innovations Inc., a 12-year-old quasi-public agency. There are few restrictions on the use of the funds. One of the most important criteria for investments, however, is that there be a direct economic benefit to the state of Connecticut.

Massachusetts' Renewable Energy Trust Fund is supported through charges to electric consumers. Total funding will reach $150 million over a five-year period, with about $25 million per year for an undefined period beyond 2002. The fund places a high priority on leveraging funds from both public and private sources.

New Jersey allocated $358 million over three years for The New Jersey Clean Energy Program. The Clean Energy Program targets technologies that save electricity and natural gas and increase the amount of electricity generated from renewable resources. Seventy-five percent (75 percent) of the fund is used for efficiency programs. Twenty-five percent (25 percent) supports renewable energy projects.

New York's Public Benefits Fund was established in 1996. Initial funding was set at $234 million for three years. In 2001, the program was extended until 2006 with an increase in funding from $78 million annually to $150 million annually. During the first three years of implementation the fund, known as the New York Energy $mart Program, produced annual electricity bill savings of $121 million, reduced electricity consumption by 932 million kilowatt hours annually, and helped create or sustain 2,300 jobs. The fund also leveraged $341 million in co-funding for the first three years.

As part of the 2003 special legislative session, Minnesota's Renewable Development Fund will receive $16 million annually from Xcel Energy. Four million five hundred dollars ($4.5 million) is allocated for wind energy production incentives and $1.5 million is set aside for production incentives for on-farm biogas recovery facilities. Currently some preference is given to the development of renewable energy projects located in Xcel Energy's Minnesota service territory.

CRITERIA FOR MINNESOTA'S RENEWABLE HYDROGEN PRODUCTION INITIATIVE

The 2003 Minnesota Legislature directed DEED to develop a targeted program to promote and encourage the development and attraction of businesses engaged in hydrogen and fuel cell technology. Any program designed to develop a hydrogen production industry in the state of Minnesota needs to take several things into account. Policymakers need to be aware that programs need to be tailored to take advantage of Minnesota's assets. Therefore, any program should meet the following criteria:

Include all of Minnesota – The forms in which hydrogen is found and stored; water, organic matter, etc… plus distribution system costs, makes it necessary that its production occur near its source. Therefore, hydrogen production in the state cannot be confined to a small number of facilities in central locations. Rather, the production of hydrogen must occur in every corner of the state to fully take advantage of Minnesota based renewable resources. Simply put, hydrogen and renewable energy resources go hand in hand. Developing Minnesota's renewable resource base will help the state gain a competitive edge in hydrogen production and foster development of a fuel cell industry in the state. Minnesota has an abundance of riches when it comes to renewable resources, specifically biomass, wind, and even solar and it is in the state's interest to develop them.

Creates Jobs and Economic Growth – The inevitable consequence of utilizing the renewable resources available within the state will be economic growth and job creation. For example, corn stover, which is currently being plowed under, could provide about $500 million to $1 billion for the agricultural sector. According to estimates in Nebraska, money spent on renewable energy has a multiplier of $2.32, while money spent on fossil fuels has a multiplier of $1.48.

Leverages Additional Funding – It is crucial that any funding be used to lure additional money into the state. New York was able to leverage $341 million in co-funding in the first three years of its New York Energy $mart Program with an initial investment of $234 million.

RECOMMENDATIONS

Based on the criteria listed above, studies of efforts in other states, and with the input of the focus group participants, DEED with support from the Department of Commerce has developed the following recommendations for a targeted program to attract businesses in the hydrogen, fuel cell, and renewable energy industries:

Energy Innovation Projects, Not Energy Innovation Zones – Only Michigan, with its NextEnergy Zone, currently employs a type of energy innovation zone. Michigan sees fuel cells as the successor to the internal combustion engine and fears it will lose thousands of jobs as a result. Thus, Michigan has launched an initiative to develop fuel cell technology as a way to preserve jobs and economic output. In context, it makes sense for Michigan to have an energy innovation zone. In Minnesota, where no such industry exists and the strength of the state lies with its renewable resource base, Energy Innovation Projects are a more appropriate tool for developing the industry. To reflect the change in the program's focus, the language in Minnesota Session Laws 2003, 1st Special Session, Chapter 11 should be changed from "Energy Innovation Zones" to "Energy Innovation Projects."

Statewide Funding Program – Establish a statewide program to fund Energy Innovation Projects (EIP) and research. The criteria for approving projects should include a provision that all funded Energy Innovative Projects have a direct economic benefit to the state of Minnesota. A review board that will evaluate the merits of projects and determine funding should administer the program. This concept was developed by the Minnesota Renewable Hydrogen Initiative Steering Committee in response to the need for an interdisciplinary board with expertise on the economic, technical, environmental and educational aspects of an EIP.

Additional Funding – In order for Minnesota to develop its hydrogen and fuel cell industries, additional investments should be considered. During the emerging stage, development of the industry is influenced by technological opportunities created by government intervention. Technological opportunities that fit within the state's science base frequently lead to the first businesses in that industry.

Resource Guide – The Department of Employment and Economic Development together with the Department of Commerce should develop a *Hydrogen and Fuel Cell Resource Guide* that provides contacts and resources for business inquirers of potential partners, experts, development locations, internet sites, programs and applicable federal, state and local policies, incentives, and funding that may apply.

Encourage and Develop Partnerships – Industry/higher education partnerships are needed to guide public research toward technologies and engineering solutions that have commercial potential. The state should develop an industry/university collaborative program directed towards the commercialization of renewable hydrogen and fuel cells, possibly based on the South Carolina Model. The state should formally recognize the Minnesota Renewable Hydrogen

Initiative (MRHI), a voluntary partnership of over two hundred Minnesotans representing government, industry, universities and non-profit organizations. Minnesota should also pursue strategic partnerships with neighboring states to develop renewable energy and hydrogen based energy systems if such partnerships offer promising opportunities for the State.

Education Program – Minnesota should develop a program to educate the public about the environmental and economic consequences of fossil fuel use and the benefits of hydrogen and renewable energy through demonstration projects and a concerted public relations campaign. Demonstration projects could include a fleet of fuel cell-powered vehicles, and traffic lights or highway construction signs powered by fuel cells. The state, in partnership with MNSCU, the University of Minnesota and its K-12 school districts should develop programs to train the next generation of scientists, engineers and technicians in the knowledge and skills necessary to install, operate, maintain and develop these new energy technologies.

Net Metering, Codes, and Standards – Minnesota should make fuel cells eligible for net metering rules and consider increasing the limit on system size. The state should develop codes and standards and help reduce local government barriers to facilitate the development of these new technologies and their implementation. Interconnection standards are crucial to the development of distributed energy projects.

APPENDIX A

Authors and Status

A bill for an act
relating to energy; modifying provisions relating to radioactive waste storage; modifying incentives and objectives for alternative energy development; requiring studies; approving consumptive use of water; amending Minnesota Statutes 2002, sections 116C.71, subdivision 7; 116C.779; 216B.095; 216B.097, by adding a subdivision; 216B.1645, by adding a subdivision; 216B.1691; 216B.241, subdivision 1b, by adding a subdivision; 216B.2411; 216B.2424, subdivision 5; 216B.2425, by adding a subdivision; 216B.243, subdivision 3b; 216C.051, subdivisions 3, 6, 9, by adding a subdivision; 216C.052, subdivisions 2, 3; 216C.41, subdivisions 1, 2, 3, 4, 5, by adding subdivisions; proposing coding for new law in Minnesota Statutes, chapters 116C; 216B; repealing Minnesota Statutes 2002, sections 116C.80; 216C.051, subdivisions 1, 4, 5.

Sec. 18. [HYDROGEN ECONOMY RESEARCH.]

(a) Notwithstanding Minnesota Statutes, section 116C.779, subdivision 1, paragraph (b), $10,000,000 from the renewable development account established in Minnesota Statutes, section 116C.779, from unobligated funds in the account as of June 30, 2003, shall be distributed to the University of Minnesota Initiative for Renewable Energy and the Environment to support basic and applied research and demonstration activities at the university. These funds shall be transferred to the University of Minnesota on or before July 1, 2003. The university shall ensure that at least $3,000,000 of these funds are available for basic and applied research, for construction and deployment of research technologies, or for other purposes in support of this research, at one rural campus or experiment station.

(b) Research funded under this section must focus on:

(1) development of environmentally sound production, distribution, and use of energy, chemicals, and materials from renewable resources;

(2) processing and utilization of agricultural and forestry plant products and other bio-based, renewable sources as a substitute for fossil-fuel-based energy, chemicals, and materials using a variety of means including biocatalysis, biorefining, and fermentation;

(3) conversion of state wind resources to hydrogen for energy storage and transportation to areas of energy demand;

(4) improvements in scalable hydrogen fuel cell technologies; and

(5) production of hydrogen from bio-based, renewable sources; and sequestration of carbon.

Sec. 19. [DEPARTMENT OF TRADE AND ECONOMIC DEVELOPMENT; PROGRAM DEVELOPMENT.]

Subdivision 1. [DEVELOPMENT OF BUSINESSES ENGAGED IN HYDROGEN PRODUCTION.] The department of trade and economic

development must develop a targeted program to promote and encourage the development and attraction of businesses engaged in the biocatalysis of agricultural and forestry plant products for the production of hydrogen, the manufacture of hydrogen fuel cells, and hydrogen electrolysis from renewable energy sources. The program may make use of existing departmental programs, either alone or in combination. The department shall report to the legislature by January 15, 2004, on legislative changes or additional funding needed, if any, to accomplish the purposes of this section.

Subd. 2. [ENERGY INNOVATION ZONES.] (a) The commissioner of trade and economic development, in consultation with the commissioners of commerce and revenue, shall develop a plan to designate not more than three energy innovation zones to spur the development of fuel cells, fuel cell components, hydrogen infrastructure, and other energy efficiency and renewable energy technologies in the state. In developing the criteria for the designations, the commissioner shall consider:

(1) the availability of business, academic, and government partners;

(2) the likelihood of establishing a distributed, renewable energy microgrid to power the zone, providing below-market electricity and heat to businesses from within the zone;

(3) the prospect of tenants for the zone that will represent net new jobs to the state; and

(4) the likelihood of the production, storage, distribution, and use of hydrogen, including its use in fuel cells, for electricity and heat.

(b) Energy under paragraph (a), clause (2), must come from one or more of the following renewable sources: wind, water, sun, biomass, not including municipal solid waste, or hydrogen reformed from natural gas up to 2010.

(c) The plan must allow for interested parties to form energy innovation cooperatives. In addition, the commissioner must consider the feasibility of the sale of energy innovation bonds for the construction of qualifying facilities.

(d) In drafting the plan, the commissioner must consider incentives for investment in the zone, including:

(1) subsidization of construction of qualifying facilities;

(2) long-term contracts for market-rate heat and power;

(3) streamlined interconnection to the existing power grid;

(4) exemptions from property tax;

(5) expedited permitting;

(6) methods for providing technical assistance; and

(7) other methods of encouraging the development and use of fuel cell and hydrogen generation technologies.

(e) The commissioner shall report to the legislature by January 15, 2004, on legislative changes and necessary funding to accomplish the purposes of this subdivision.

APPENDIX B

Focus Group Participants

November 2003

Facilitator:
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Project Leader:
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APPENDIX C

positively Minnesota
Department of Employment and Economic Development

Minnesota Department of Commerce

The fuel cell and renewable hydrogen industries are promising growth opportunities for Minnesota. The Minnesota Departments of Employment and Economic Development (DEED) and Commerce (DOC) invite you to join colleagues from around the state on November 6th, 12th or 13th to discuss how government can best nurture these exciting industries.

These meetings are a response to legislative action (see attached file) asking the departments to submit a report by January 15, 2004 that provides recommendations on:

- a targeted program to promote and encourage the development and attraction of businesses engaged in the biocatalysis of agricultural and forestry plant products for the production of hydrogen, the manufacture of hydrogen fuel cells, and hydrogen electrolysis from renewable energy sources.
- a plan to designate not more than three energy innovation zones to spur the development of fuel cells, fuel cell components, hydrogen infrastructure, and other energy efficiency and renewable energy technologies in the state.

We are hoping to get your thoughts on a variety of topics including:

- How can Minnesota jump start an emerging fuel cell and renewable hydrogen energy industry?
- What opportunities for fuel cells and/or renewable hydrogen production, storage, distribution and use look most promising for Minnesota?
- What strengths (barriers) does Minnesota offer to the renewable hydrogen and fuel cell component industry? How can we overcome or reduce the barriers?
- What projects and incentives should be offered within an Energy Innovation Zone to support industrial development in the renewable hydrogen and fuel cell field?

The meetings will be held from 9:00 to 11:30 a.m. at DEED's Metro Square Offices (500 Metro Square Building, 121 7th Place East, St. Paul). Space is limited and must be reserved. Please **RSVP to Linda Limback at linda.limback@state.mn.us with the dates (Nov 6, 12, 13) that you would be available.** We will try to accommodate as many participants as possible.

If you cannot attend one of the meetings in person but would like to attend by phone, please let Linda know. We can arrange conference call attendance if needed.

If you have any questions, please contact Linda Limback (651-296-1883), or Gene Goddard (651-296-7102 or gene.goddard@state.mn.us.

Sincerely,

Matt Kramer
Commissioner

Edward Garvey
Deputy Commissioner

APPENDIX D

SECTION I
Introduction:

The emergence of new products such as fuel cells and renewable energy presents a short window of opportunity for industrial growth through expansion of existing firms and the founding of new ones. We think that this stage of emerging industrial development can be influenced by such factors as the natural resource base, the regional science and knowledge base, and government policy. We have asked you here today to get your input about the kinds or programs, partnerships and/or policies that the State of Minnesota can develop and implement to advance the development of industries in this new technological field.

One of the most important aspects of product development is market demand. Let's talk a bit about market demand as it relates to fuel cells and renewable hydrogen.

I. Market Questions

What are some of the global drivers that are creating market demand for fuel cells and hydrogen?

How do these drivers affect or impact Minnesota? And are there ways that the State can affect these market drivers or create new ones to accelerate growth, and if so, what are some of them?

Do you think that creating a local demand for hydrogen or fuel cell applications make a difference to the growth of a local industry? If so, how?

How would you rate the pace of technological development in the fuel cell industry? In the renewable H2 industry?

Do you think that the business community in the U.S. is keeping up with the pace of development? Why or why not? How about the MN business community?

Do you think the U.S. government has been responsive to the needs of this industry in providing adequate assistance? The MN government?

II. Strengths Weaknesses Opportunities Threats (SWOT) Analysis

In addition to MARKET, we need to talk about opportunities within these emerging industries that look most promising for the state and identify barriers to their development in Minnesota so we can reduce them.

Which technologies look most promising now (within the next 3 years and the next 5-6 years)?
⟹ Point to poster displaying legislation but also prompt for ANY OTHER ideas.

How developed are these technology systems? Are there gaps in the equipment, peripherals or processes that need to be developed or improved before these technologies are ready for a mass market?

Should the state target specific technologies and/or technology gaps for development and use public resources to help further their development?

Prompt: Remember to consider 1. Production 2. Storage; and/or 3. Distribution

How should it determine which one should be targeted? What process should it use, who should be involved? How specific should the State get in determining technologies to target? Are there some areas or technologies within these fields that the State should avoid committing resources?

Should the State target specific applications (transport, stationery, portable, micro) as a strategy to promote H2 production and what kind of applications make most sense for Minnesota to pursue?

What barriers to growth in these industries do you perceive in MN compared to other locations, and how can we eliminate or reduce these barriers?

III. Resource and Science base

Does MN have the regional science base to solve some of these gaps in technologies and is that science base currently directed at creating the products and processes to help in the development of these "gap" technologies?

Are there further measures, programs or partnerships that the State can implement to help direct that science base toward developing the technologies toward solving some of these gaps and, if so, what would you recommend?

IV. Program and Policy

There is an innate high risk involved in development of new technologies in these areas, especially when the energy produced may need an entirely different infrastructure. Are there things the State can do without jeopardizing its resources to reduce the risk of investment? If so, what kinds of things?

Do different technologies need different policies or incentives?

I'm going to mention some of the areas that are frequently targeted by state level programs as important to supporting growth of industries. Please tell me if you think actions in these areas would enhance industry growth in the renewable hydrogen and fuel cell industry and what actions under these heading should Minnesota take.

Read each heading:

State government leadership – goals or mandates
Research and development
Demonstration projects
Information and education
Tax incentives and/or financial assistance
Government deployment – early adopters
Regulations, codes and standards
Other

Not including the deep scientific and engineering information that pertains to these technologies, are there other sets of information, analysis or studies that needed to be conducted to help the State make good decisions on how to proceed, and if so, please identify which areas need further study to provide the State with better information ion which it can base decisions?

In summary, how best can Minnesota jump start a renewable hydrogen and/or fuel cell industry in the state? What do you think are the most important things that the State should do to foster development of the technologies and an associated industry? Force an answer from each person to this question.

SECTION II
Questions on Energy Innovations Zones:

⟹ Let's think a bit about the concept of an Energy Innovation Zone.
Please look up to the first paragraph under "Energy Innovation Zones" on the wall.
The purpose of Energy Innovation Zones is to spur development of fuel cells and components, H2 infrastructure, and/or other energy efficiency and renewable energy technologies.

How do we spur development. What comes to mind? Let's list some of the components, features, principles that you think might be involved in an Energy Innovation Zone.

What kind of businesses would be interested in such a zone?

What uses do you see for the energy produced in such a zone?

What role would the State and the local government need to play to create such a zone?

In most cases, building an innovative energy systems as part of an Energy Innovation Zone is going to demand a high capital investment. Yet, the legislation asks that we consider the likelihood of providing below-market electricity and heat to businesses from within the zone. Let's discuss costs of renewable energy a bit in light of this request. Even with some level of subsidization, are there technologies that once up and running can be expected to provide below-market energy? If so, please tell us a bit about which ones you would suggest?

Does anyone have other suggestions for how energy from such a zone can be offered at below market rates?

What are some of the primary resources in Minnesota that may be attractive to potential firms in the production of hydrogen or the manufacturing of fuel cells.

Are there some natural locations for such a zone? Where and why?

The 2003 Legislature directed the DEED commissioner, in consultation with the commissioners of commerce and revenue to consider the criteria listed on the poster above for the designations. Let's talk a bit about those criteria. Do they all make sense? Are there other criteria that should be included on this list?

The Legislature also requires the DEED commissioner to consider the feasibility of the sale of *energy innovation bonds* for the construction of qualifying facilities. Incentives for investment in the zone must include the following:

a. Subsidization of construction of qualifying facilities
b. Long-term contracts for market-rate heat and power
c. Streamlined interconnection to the power grid
d. Exemptions from property tax
e. Expedited permitting
f. Methods for providing technical assistance

What other incentives should be adopted by the state to promote businesses that develop the fuel cell/hydrogen industry in Minnesota?

Minnesota has tended to "incentivize" energy technologies, rather than locations/zones. What advantages and/or disadvantages does incentivizing a zone have over a technology? Which concept, if either, would work better?

Thank you for taking the time to come in today to provide your ideas. It was so good to meet many of you for the first time face to face. Dr. Art Adiarte will be analyzing the results of these structured discussions and he will use them to make recommendations on what actions the state needs take or what programs must be developed or expanded to foster the development of these industries in Minnesota.

We will **provide you each with a copy** of the final report when it is sent to the legislature in mid-January.

APPENDIX E

FUEL CELL AND HYDROGEN INCENTIVES BY STATE

STATE	PROGRAM Construction & other	Loan Programs	Grant Programs	Property Tax	Industy Recruitment	State Rebates	Personal Taxes	Sales Tax	Corporate Tax
AR					50% tax credit for construction or purchase of FC production facility				
CA		low interest loans				$4.50/ watt or 50% of cost			
GA							$2500 for LEV $5000 for ZEV		$2500 for LEV $5000 for ZEV
HI					100% tax credit on equity investment				
IL			FC grants for schools, 501c's up to $550,000 per project						
IN			1. $2,000-$30,000 for alt fuel vehicles 2. Up to $30,000 for distributed electricity production						
KS			1. $200,000 avail for projects				1. $3000-50000 for vehicles 2. Up to $200K tax credit for alt fuel stations		1. $3000-50000 for vehicles 2. Up to $200K tax credit for alt fuel stations

APPENDIX E (continued)

STATE	PROGRAM construction & other	Loan Programs	Grant Programs	Property Tax	Industy Recruitment	State Rebates	Personal Taxes	Sales Tax	Corporate Tax
MA			1. FC grants totaling $5 million 2. Green bldg grants				100% deduct for 5 years on any alt energy patent		100% deduct for 5 years on any alt energy patent
MD							30% tax credit for install of fuel cell system	100% sales tax exempt	30% tax credit for install of fuel cell system
MI			$240 mil over 6 yrs for FC grants through low-income and energy-efficiency programs		1. 100% credit on all alt energy equip, propert taxes, and education taxes. 2. 100% of state income taxes paid by company's employees refunded to company				
MT		low interest loans, $10,000 limit					1. $500 tax credit for home system 2. $500 for vehicle conversion		Commercial and net metering investments receive 35% tax credit on minimum $5000 investment
NV								FC purchase exempt from local tax	
NY	10% of state gov energy from renewable resources		$10 mil for projects						$25 million in tax credits. 30% of capitilized costs. (6% x 5yrs)
OH		low interest loans. $25K residents $500K bus	$25 million designated for R&D and demo projects		$15 mil for FC grants, loans				

APPENDIX E (continued)

PROGRAM

STATE	Construction & other	Loan Programs	Grant Programs	Property Tax	Industy Recruitment	State Rebates	Personal Taxes	Sales Tax	Corporate Tax
OR				no tax assessment on new systems			up to $1500 for home or vehicle		
PA		low interest loans	at least $47 mil avail for grants						
RI	3 cent/kWh incentive		$500,000 for grants						
TX	alt energy construction mandate if economically feasible								
UT							up to 50% or $3000 for alt fuel vehicle		
VA					$700 tax credit for each job created				
VT								FC and equip exempt from state sales tax	
WA								FC and equip exempt from state sales tax	
WY								FC and equip exempt from state sales tax	