Fuel Cells: Present and Future

NAS/NIST TIP Symposium

Clean, Reliable On-site Energy

William D. Ernst
April 24, 2008

SAFE HARBOR STATEMENT

This communication contains forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995, including but not limited to our 2008 milestones and statements regarding our growth plans. We believe that it is important to communicate our future expectations to our investors. However, there may be events in the future that we are not able to accurately predict or control and that may cause our actual results to differ materially from the expectations we describe in our forward-looking statements, including, without limitation, the risk that the anticipated synergies of the Cellex Power Products, Inc. and General Hydrogen Corp. (now amalgamated as Plug Power Canada Inc.) acquisitions are not realized; the risk that unit orders will not ship, be installed and/or convert to revenue, in whole or in part; Plug Power's ability to develop commercially viable on-site energy products; the cost and timing of developing Plug Power's on-site energy products; market acceptance of Plug Power's on-site energy products; Plug Power's ability to manufacture on-site energy products on a large-scale commercial basis; competitive factors, such as price competition and competition from other traditional and alternative energy companies; the cost and availability of components and parts for Plug Power's on-site energy products; Plug Power's ability to establish relationships with third parties with respect to product development, manufacturing, distribution and servicing and the supply of key product components; Plug Power's ability to protect its Intellectual Property; Plug Power's ability to lower the cost of its on-site energy products and demonstrate their reliability; the cost of complying with current and future governmental regulations; the impact of deregulation and restructuring of the electric utility industry on demand for Plug Power's on-site energy products; and other risks and uncertainties discussed under "Item IA—Risk Factors" in Plug Power's annual report on Form 10-K for the fiscal year ended December 31, 2007, filed with the Securities and Exchange Commission ("SEC") on March 17, 2008, and the reports Plug Power files from time to time with the SEC. Plug Power does not intend to and undertakes no duty to update the information contained in this presentation.

FUELS CELLS ARE BECOMING AVAILABLE

Fuel Cells are contained within stacks/systems and can electrochemically convert hydrogen, hydrocarbons and carbon monoxide to electricity and heat with high efficiency and low emissions

Fuel Cells are being developed world-wide in portable, micro, stationary and transportation applications

Fuel Cell technology is moving toward commercialization but is early from the high volume manufacturing perspective with a few exceptions

2006 Worldwide Fuel Cell Industry Survey

- Sales increased by 7% from $331M in 2004 to $353M in 2005
- R&D Expenditures increased to $796M
- Employees increased to 7,074

Source: USFCC 2006 Industry Survey

WHAT DO FUEL CELLS HAVE TO OFFER?

- **Address National Energy and Security concerns**
  - Reduced fuel consumption
  - Fuel flexibility and alternatives
  - A path to energy independence
- **Environmental benefits**
  - Greenhouse gas emissions – significantly reduced or eliminated
  - Reduced hazardous material handling and clean-up
  - Quiet
- **System reliability**
  - Runs more predictably than batteries
  - Significant advantage for extended run times
  - Grid Complement or Grid Independent
- **Reduced costs**
  - Lower maintenance costs than batteries
  - Lower operating costs (higher efficiency)
  - Lightweight
  - Scalable

FUEL CELL APPLICATION CLASSES

- Sub-kilowatt (milliwatts to 1 kWe)
  - Micro, portable
    - Cell phones, laptops, small battery chargers, etc
    - Fuels include: hydrogen, hydrides, methanol, etc
- Kilowatt (2 kWe to 100 kWe)
  - **Stationary (Small)**
    - **Back-up, motive (material handling), continuous power (grid independent)**
    - **Fuels include: hydrogen, hydrocarbon (NG, LPG, liquid, etc), renewables**
  - Transportation
    - Fuel: principally hydrogen (USA)
- Multi-kilowatt (200 kWe to megawatt)
  - Stationary (Large)
    - Utility, distributed power
    - Fuels include: hydrocarbon (coal, NG, LPG, liquid, etc), renewables, etc

KILOWATT CLASS EXAMPLES

INDUSTRY-WIDE CHALLENGES FOR FUEL CELLS

- Technology
  - Materials
  - Systems
  - Cost
  - Efficiency
  - Lifetime
- Manufacturability
- Codes and Standards
- Hydrogen Concerns

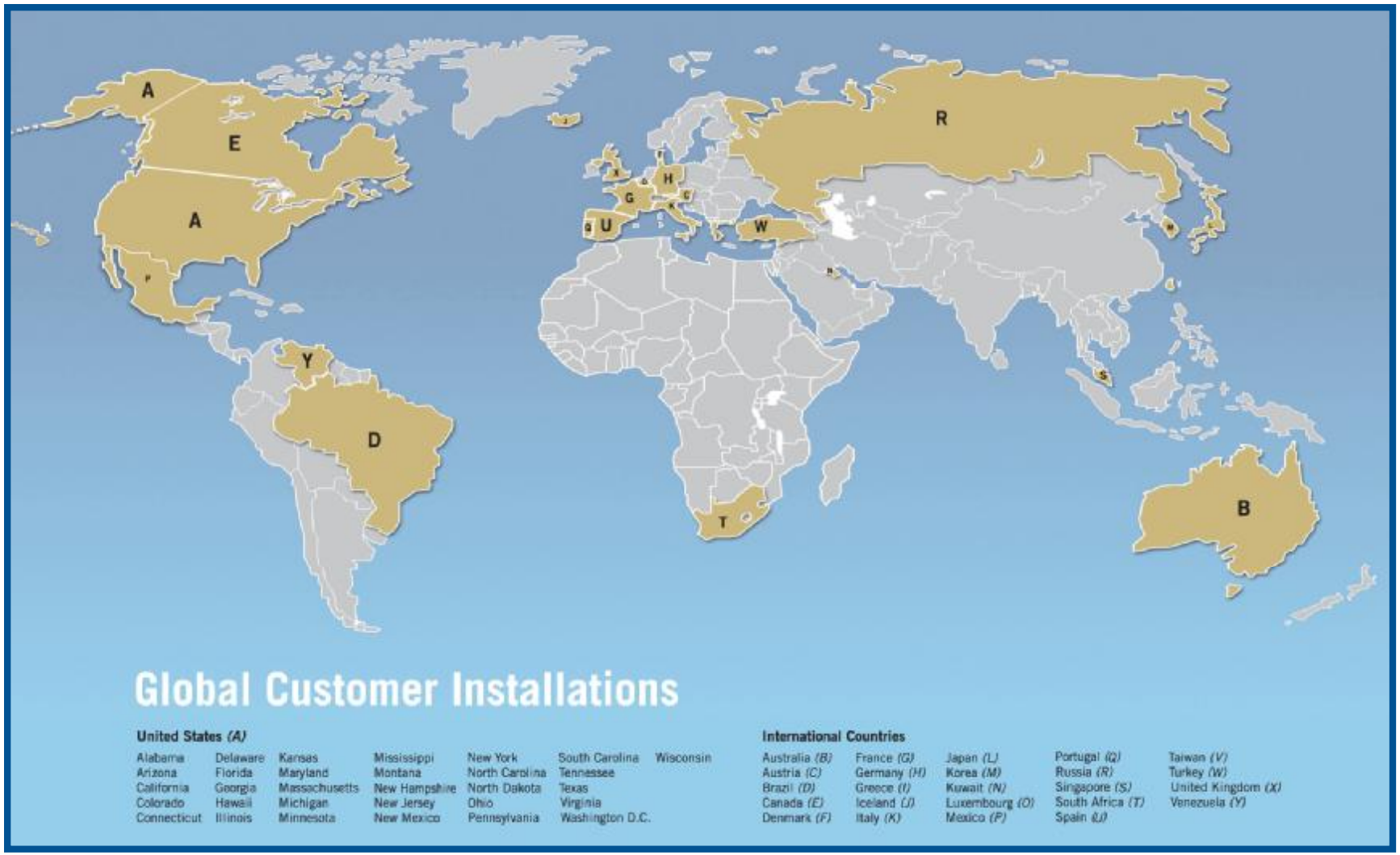
PLUG POWER VISION STATEMENT

To be the leading provider of clean, reliable on-site energy solutions.

PLUG POWER

- Plug Power, founded in 1997, is a development stage company, addressing the kilowatt class stationary market with ~ 390 employees.
  - Develop, manufacture, market, supply and service fuel cell power systems worldwide
  - Three divisions: Back-up Power, Motive Power and Continuous Power
- Investment (operating loss) to date - over $540 Million
  - Stock holders provided over 85%
- Early-commercial available products include:
  - GenCore® (PEM) backup power system at 5 kWe
  - GenDrive™ (PEM) motive power systems (Forklift type) (3 -12 kWe)
- Potential products in various stages of development from concept to field test include:
  - Alternate configurations (PEM) for backup power systems (2 - 6 kWe)
  - GenSys® (PEM) for continuous grid or grid independent use (5 kWe)
  - HT PEM for continuous CHP applications (2 -12 kWe)
  - SOFC for continuous, grid independent use (2 -12 kWe)

FIELD PROVEN



GenCore

GenCore systems operating in 25 counties

as of 5/2007

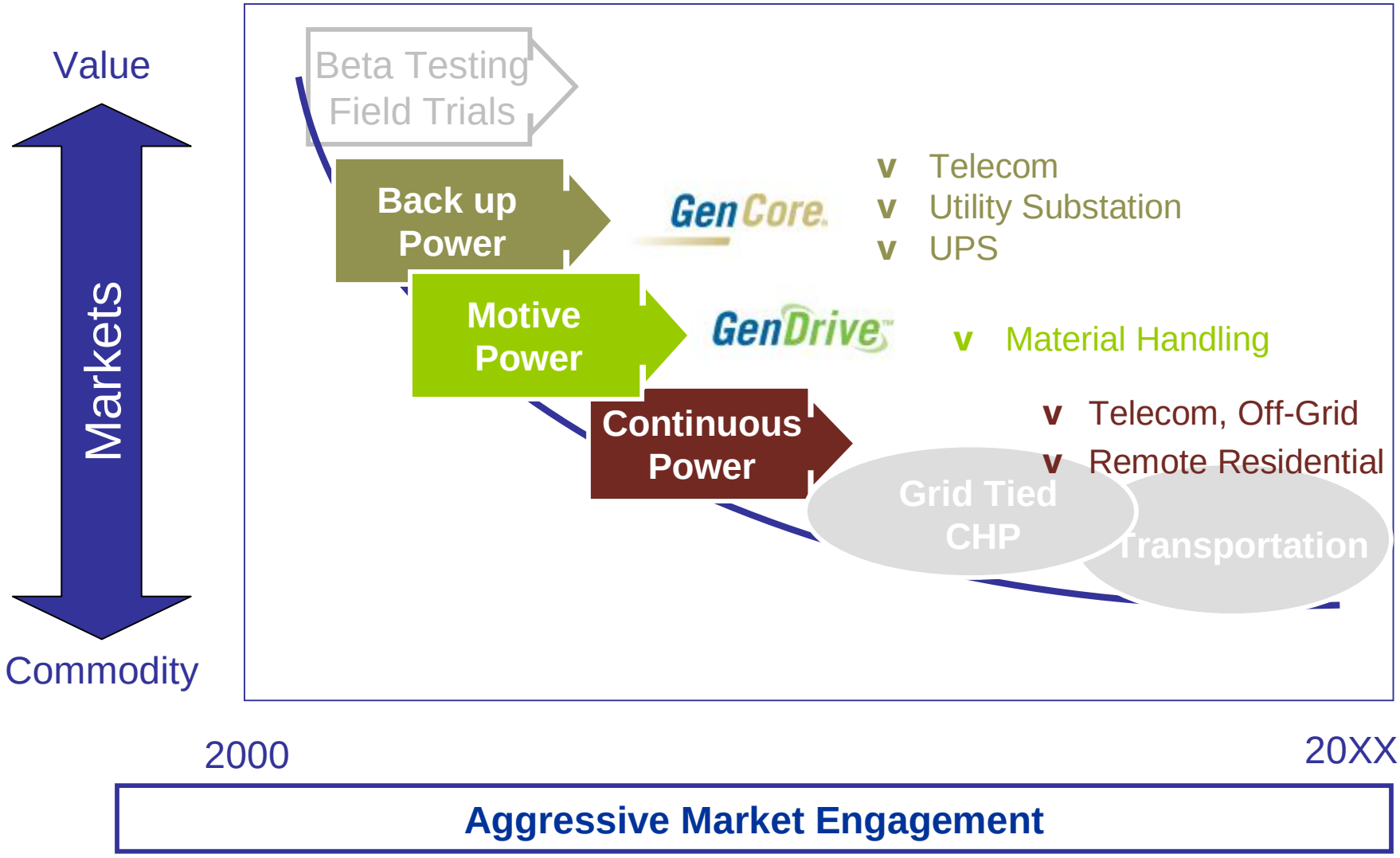
PLUG POWER'S STRENGTHS

- Global market knowledge as an industry leader
- Six years of market engagement
- **Understand customer needs**
- **Strong balance sheet that provides flexibility**
- Well-known brand name
- Product integration experience
- Proven track record of "field-testing" and servicing of products
- Solid partnerships, alliances and government relations

ANDREW MARSH, PRESIDENT AND CEO

- New President and CEO, effective April 8, 2008
- Telecom industry veteran brings extensive experience in product and market development and growing revenues
- Co-founder of Valere Power where he served as CEO from 2001 to 2007

ADOPTION CURVE



GENCORE® TARGETS THE $1.9B USD[1] GLOBAL BACKUP BATTERY MARKET FOR THE TELECOM INDUSTRY

- **System Reliability Improvement**
  - Extended run
  - Scalable backup power
  - Remote monitoring and diagnostics
  - Redundancy or replacement
- **Operating Expense Reduction**
  - Eliminates battery replacement and maintenance
  - Reduces personnel callouts during outages
  - Alleviates space shortages for next-generation telecom networks
  - Reduces customer churn resulting from network outages

GenCore® 5T fuel cell system with cell tower

1 Source: Frost and Sullivan.

BACK-UP POWER MARKET

For the first time, the FCC has mandated specific backup power time requirements of 24 hours for central offices and 8 hours for outside plant and cell sites.

- Fuel cells provide a predictable, reliable and sustainable solution addressing critical backup needs
- New ruling requires all wireless carriers to inventory their infrastructures and re-evaluate their backup strategies
- Companies are collaborating with fuel cell solution providers for go-to-market collaboration
- Leads to a strong consideration of fuel cells

GENDRIVE™ TARGETS THE $1.5B USD[1] MOTIVE BATTERY MARKET FOR THE MATERIAL HANDLING INDUSTRY

Class 1

Sit-down lift trucks:
Handle heavy loads in large manufacturing operations

Class 2

Stand-up reach trucks:
Provide flexibility and maximum floor space Utilization in large distribution centers

Class 3

Rider pallet trucks:
Select goods within large distribution centers before delivery to retail stores

1 Source: Enersys Corporate Info World Presentation, 9/2006

CONTINUOUS POWER MARKETS

v Wireline/Wireless Telecommunications

- Remote Cell Towers, microwave repeaters
- Allows base station deployment independent of the utility infrastructure

v Oil & Gas

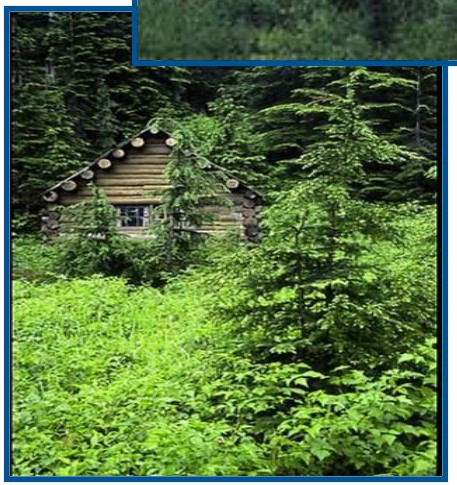
- Valve hubs, cathodic protection, etc
- Product offers wide power range at low cost relative to alternate technologies

v Remote Power

- Off-grid homes and cabins
- Higher grid-like standard of living
- Third world applications

v Residential Combined Heat & Power

- Works in parallel to the grid
- Produces heat, hot water with electricity as byproduct
- Expect significant savings for consumers in northern climates
- Significantly reduces carbon footprint of home



How NIST ATP helped in Addressing Challenges
Why is NIST support needed?

- Venture capital industry seeks manageable risk and plausible exit strategy, longer term development risk requires additional investment
- High risk/high payoff, longer term technology development competes for internal resources against lower risk product development
  - Company balance sheet must cover period to profitability and can not shortchange existing internal product development which is less risky and closer to maturity (profitability)
- NIST support typically cuts company investment by 50%
- NIST proposal process rigor helps clarify markets and objectives
- Acknowledgement by outside, reputable agency (NIST) of technology feasibility entices further internal resource allocation by management

How NIST ATP helped in Addressing Challenges
Benefits of NIST Support

- Plug Power won three ATP awards over 10 years and lost two
  - HT PEM (Total-$9.7MM, NIST-$4.7MM, Plug-$4.3MM, Sub-$0.7MM)
  - Novel Reformer(Total-$2.2MM, NIST-$0.8MM, Plug-$1.4MM)
  - Low Cost System (Total-$5.6MM, NIST-$1.9MM, Plug-$3.7MM)
  - Overall Plug Cost Share ~55%

- Projects focus was cost reduction: membrane, stack and system

- NIST award fostered technology advances that edged HT PEM closer to product status
  - HT PEM membrane development initiated in NIST program with membrane subcontractor was unsuccessful but stack and system work progressed
  - Membrane development continued with another sub and has become successful with additional cost shared funding from DOE, NYSERDA and EU.
  - Product development is still not complete but effort has led to potential support by a user group to sponsor a pending multiple unit field trial which is the next step to commercialization

How NIST ATP helped in Addressing Challenges
Technology / Product Development Example

- NIST HT PEM Program led to the development of a gel based polybenzimidazole (PIB) membrane
- Stacks and systems were developed around PIB membrane and its potential for long life and low cost.
- Market knowledge in conjunction with the performance features of the PBI stack identified combined heat and power (CHP) as the target application
- A viable product requires both technology and the correct application to proceed to commercialization
- Further, since product development is a typically a multi year, phase-gated process the overall process took about five years
  - Technology development - typically one to two years from technology concept to technology readiness/decision to productize
  - Product development - typically two years for best-in-class development from technology readiness to initial launch with adequate resourcing
- Conclusion: Technology commercialization is exceptionally difficult to plan and schedule
  - Innovation is not programmable but can be facilitated

Comment: Impact of Previous Awards on Future Awards

- In evaluating the past record of potential awardees, schedule slippage in completing product development goals should be counterbalanced by tenacity of potential awardees in continuing to resource and pursue objectives beyond NIST program completion.

Critical National Needs In Fuel Cells

Where are we now?

- **The need for fuel cells having high efficiency and low emissions with available fuels at reasonable cost is becoming ever more critical due to:**
  - Increasing fuel consumption and declining supply
  - Growing conflict between food and fuel needs
  - Pressing Energy and National Security Demands
- **DOE FE is focusing on Multi-kilowatt class SOFC fuel cell power systems using coal as the fuel and sequestering the CO2**
- **DOE support of transportation application technology development using hydrogen are progressing in the US and internationally**
  - Development of hydrogen as an energy carrier for transportation applications is proceeding slowly based on the challenges of hydrogen storage and cost
- **Agencies such as DOE EERE are recognizing that Kilowatt class fuel cell power systems need development for point-of-use continuous applications as evidenced by the addition of SOFC technology to their development plans**
  - Higher overall efficiency results from **point-of-use** systems
  - Increasing attention to hydrocarbon and renewable fuels suitability and availability
- **Fuel cell use is increasing but its economics, reliability and availability have not yet reached high volume commercial viability**

Critical National Needs In Fuel Cells

Where are we going?

- Kilowatt class continuous power technology development has lagged behind other applications
  - Low cost PEM fuel cell know-how developed for transportation was leveraged to provide low cost stacks and systems for hydrogen based applications (back-up and motive power) but timing and different fuel needs reduced the benefit to hydrocarbon based applications
  - Transportation and megawatt class applications have been highly funded
- Kilowatt class multi fuel capable technology is critical to provide energy security and flexibility
  - Grid independent (remote) power is a world wide need
- Kilowatt class fuel cell power systems for continuous point-of-use applications need to be considered in satisfying national needs for electrical and total efficiency
  - Increasing emphasis required for development of higher efficiency systems like SOFC that are potentially simpler, more flexible and more tolerant to use of multiple fuels

Critical National Needs In Fuel Cells

How do we get there?

- Continue to support the demonstration of hydrogen based small stationary back-up and motive system applications leveraging technology from the transportation industry and investing in innovative technology especially concerning hydrogen storage and cost.
- Increase support for development of innovative technology for kilowatt class continuous power applications in such areas as:
  - Innovative, low cost system configurations for high efficiency power
  - High temperature low cost, non-nickel, non-corroding materials for heat exchangers and reactors
  - Low cost, low thermal conductivity, high temperature castable insulation
  - Sulfur tolerant steam reforming catalysts


PLUG POWER. PLUG WILL.

plug power

HEADQUARTERS
968 Albany-Shaker Road
Latham, New York 12110
Phone: (518) 782-7700
Fax: (518) 782-9060

CANADA
13120 Vanier Place
Richmond, BC V6V 2J2
Canada
Phone: (604) 303-0050
Fax: (604) 231-0400

EUROPE, MIDDLE EAST & AFRICA
7301 BC Apeldoorn
P.O. Box 880
The Netherlands
Phone: 31 55 53 81 000
Fax: 31 55 53 81 099

WASHINGTON, D.C.
499 South Capitol Street, SW
Suite 606
Washington, D.C. 20003
Phone: (202) 484-5300
Fax: (202) 554-2896

www.plugpower.com