

Fuel Cell Applications-Update

2nd Annual Automotive Composites
Conference

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MSU Education Center

Troy, MI

Anthony A. Androsky
Deputy Executive Director
US Fuel Cell Council

From Dream to Reality

"Yes, my friends, I believe that water will one day be employed as fuel, that hydrogen and oxygen which constitute it...will furnish an inexhaustible source of heat and light...and ...as long as the earth is inhabited, it will supply the wants of its inhabitants..."

- Jules Verne, The Mysterious Island 1874

Mission

Formed in 1998, the U.S. Fuel Cell Council is organized as a nonprofit industry association (501(c)(6)) open to anyone who shares our goal of fuel cell commercialization in the United States.

The Council provides its members an opportunity to develop policies, and conduct education and outreach activities for the fuel cell industry, and also gives every member the chance to benefit from one-on-one interaction with colleagues and opinion leaders important to the industry. Members have access to exclusive reports and analysis prepared by the Council, and to the “members only” section of our web site.

USFCC

-Just another trade association?

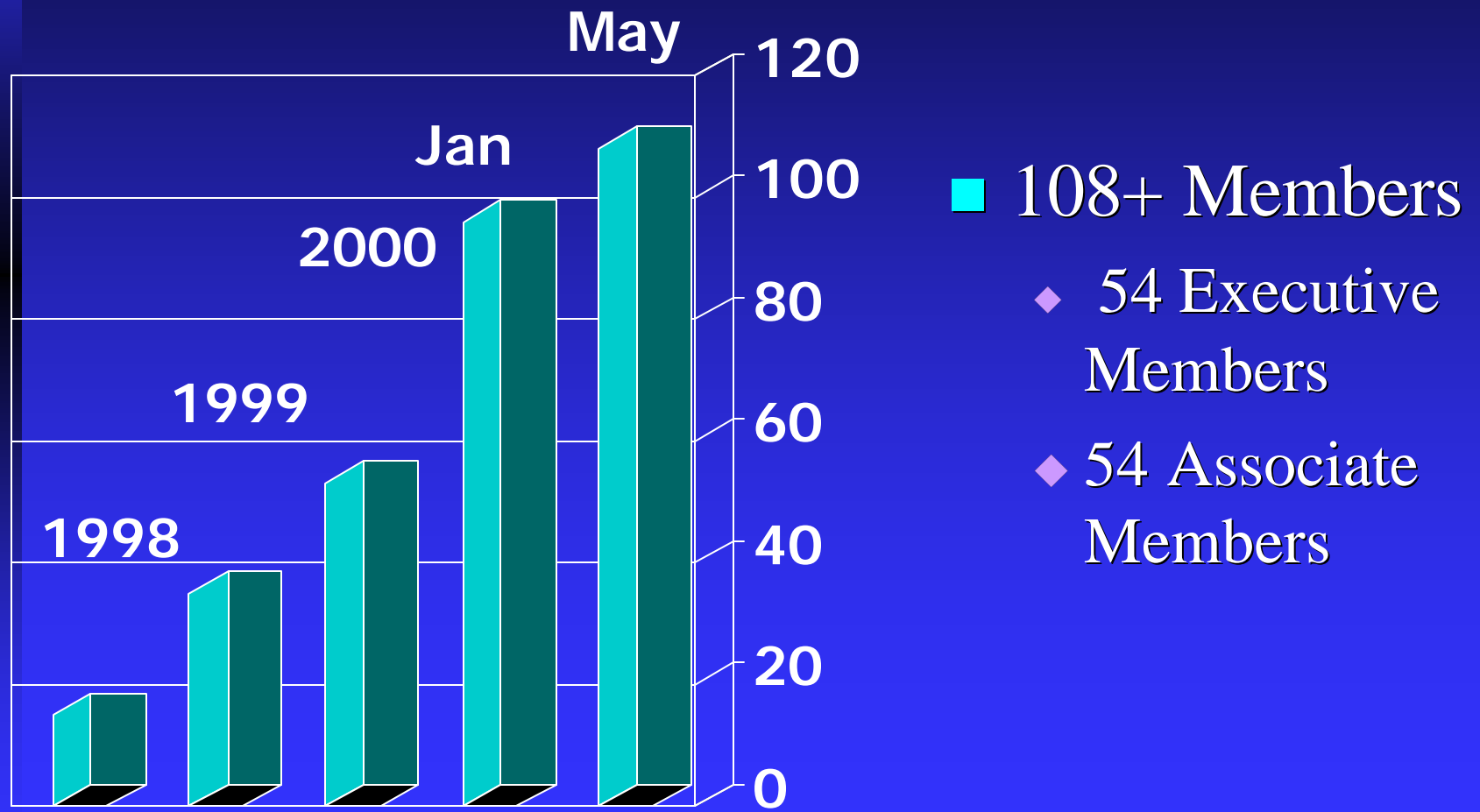
- US in name, GLOBAL in scope
 - ◆ International member “companies”...
 - ◆ Archstone of ISO, IEC
 - ◆ Direct link to WP-29
 - ◆ Direct link to EIHP-2
 - ◆ Prime source for information on vehicle GTR
 - ◆ Direct link to the JEVA

USFCC

-Just another trade association?

- Managing emerging markets, with USFCC as the universal model
 - ◆ WFCC
 - ◆ South America
 - ◆ Affiliates
 - ◆ Working Groups
 - ◆ Committees

USFCC Membership Growth



USFCC Structure – Working Groups

- Codes and Standards
- Education and Outreach
- Stack Materials and Components
- Transportation
- Portable Power
- Power Generation

USFCC-Working Groups (cont)

- Forecast
 - ◆ Sustainable Development
 - ◆ Recyclibility
 - ◆ Materials specs
 - ◆ LCIs
 - ◆ Cities, States, Regions
 - ◆ Coalition/consortia efforts
 - ◆ Collaboration (closed door AND pre-competitive)
 - ◆ Cooperative Research
 - ◆ Code harmonization

USFCC

Council Forecast...and then some

- Fortify **established** industry voice
- **Maintain** the infrastructure for and **fortify** global recognition as the “clearinghouse” for Codes, Standards, Recommended Practices/GTR/Local, Federal and International arena
- Professional Leadership
 - ◆ Professional Individual Membership
 - ◆ Continuing Education/Professional Development

What's a Fuel Cell?

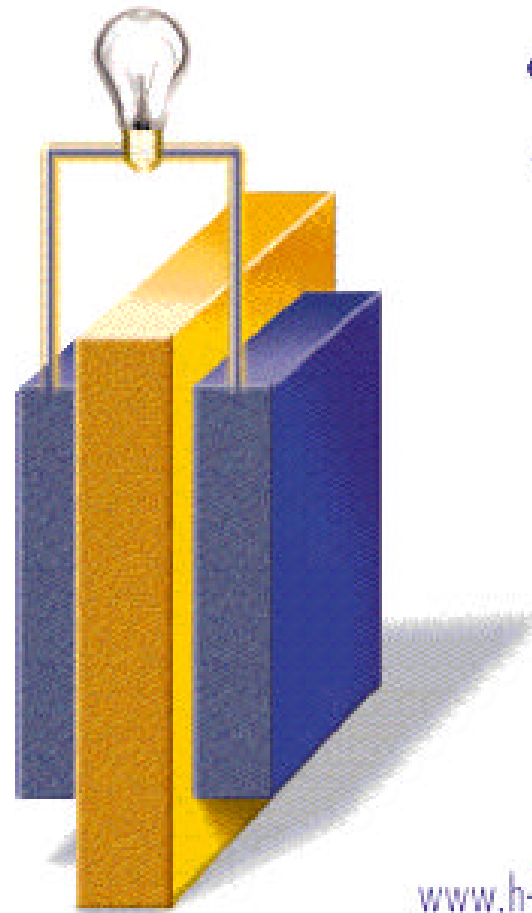
Fuel Cells - Defined



“Fuel Cells are electrochemical devices that convert the chemical energy of reaction directly into electrical energy.”

Fuel Cells: A Handbook

Fuel Cells - Concept

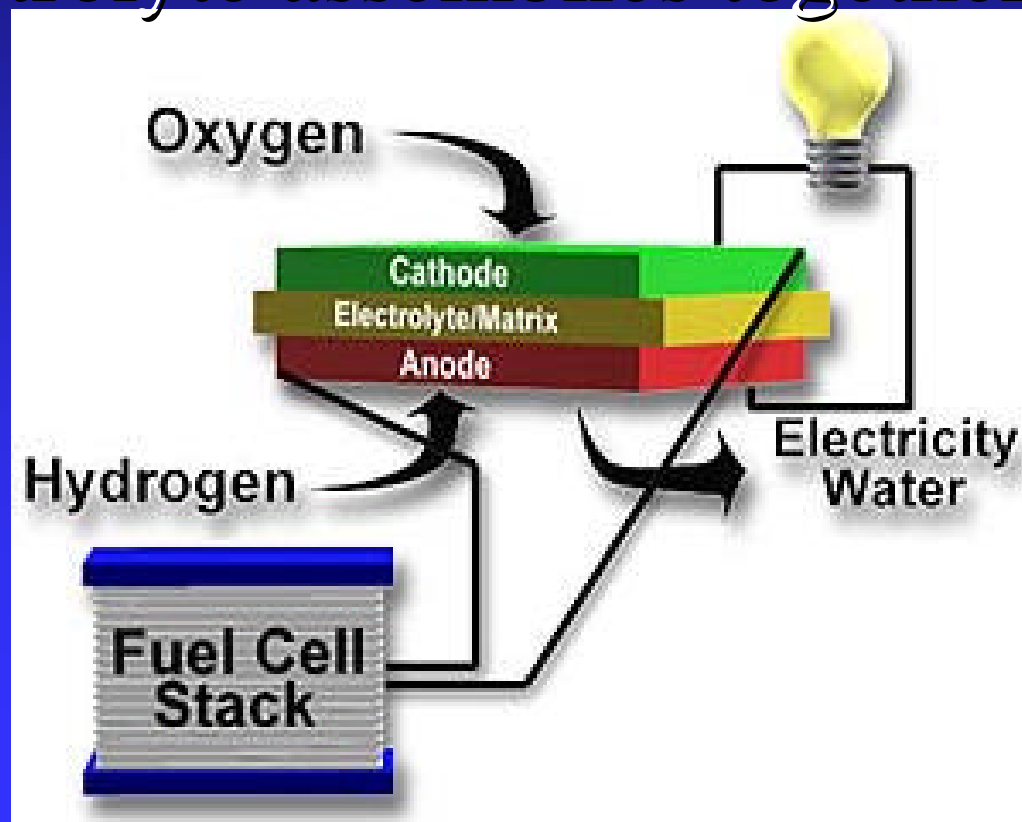


www.h-tec.com

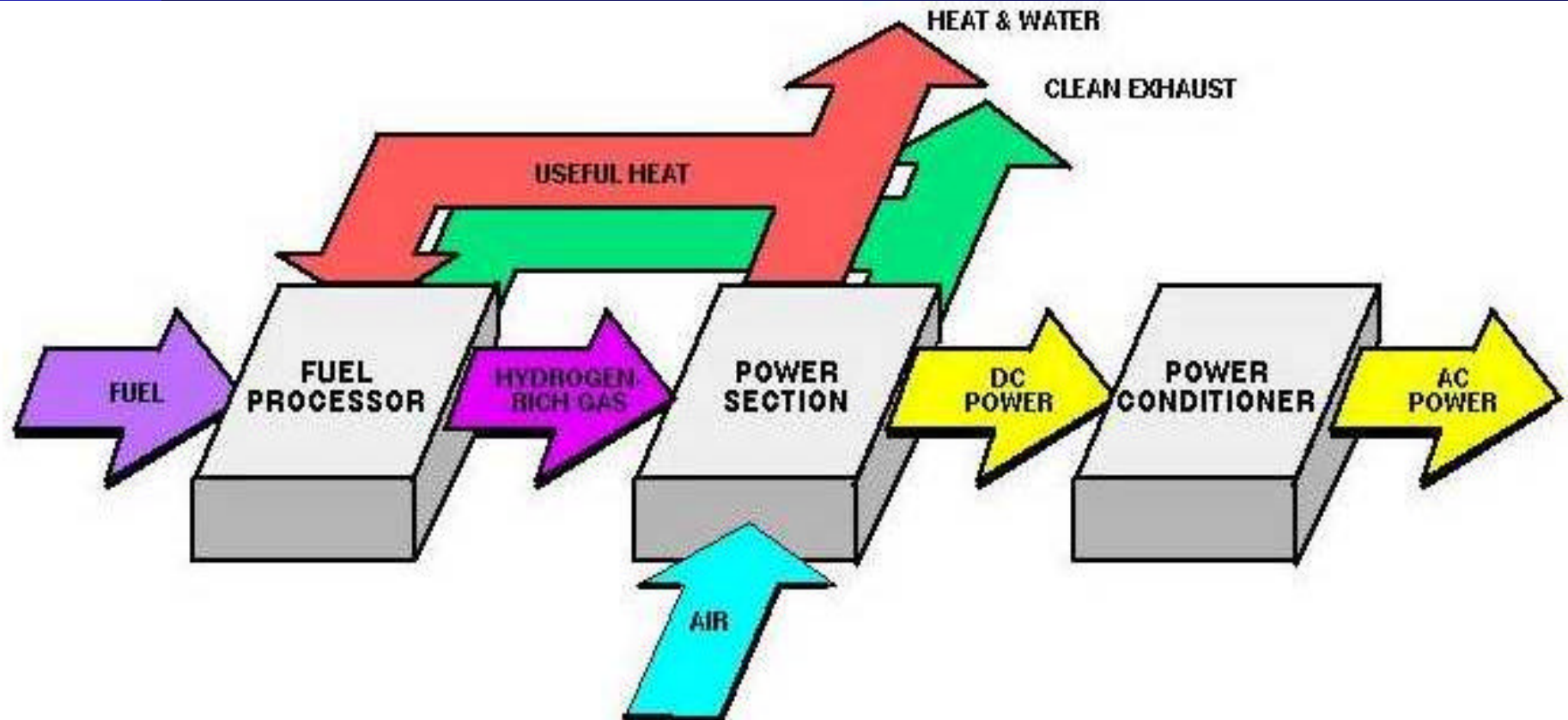
Fuel Cells - Concept

Increase voltage to useful levels.

- Bundle or 'stack' many electrode / electrolyte assemblies together.

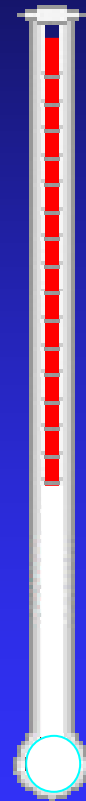


Fuel Cell System



Fuel Cell Technologies

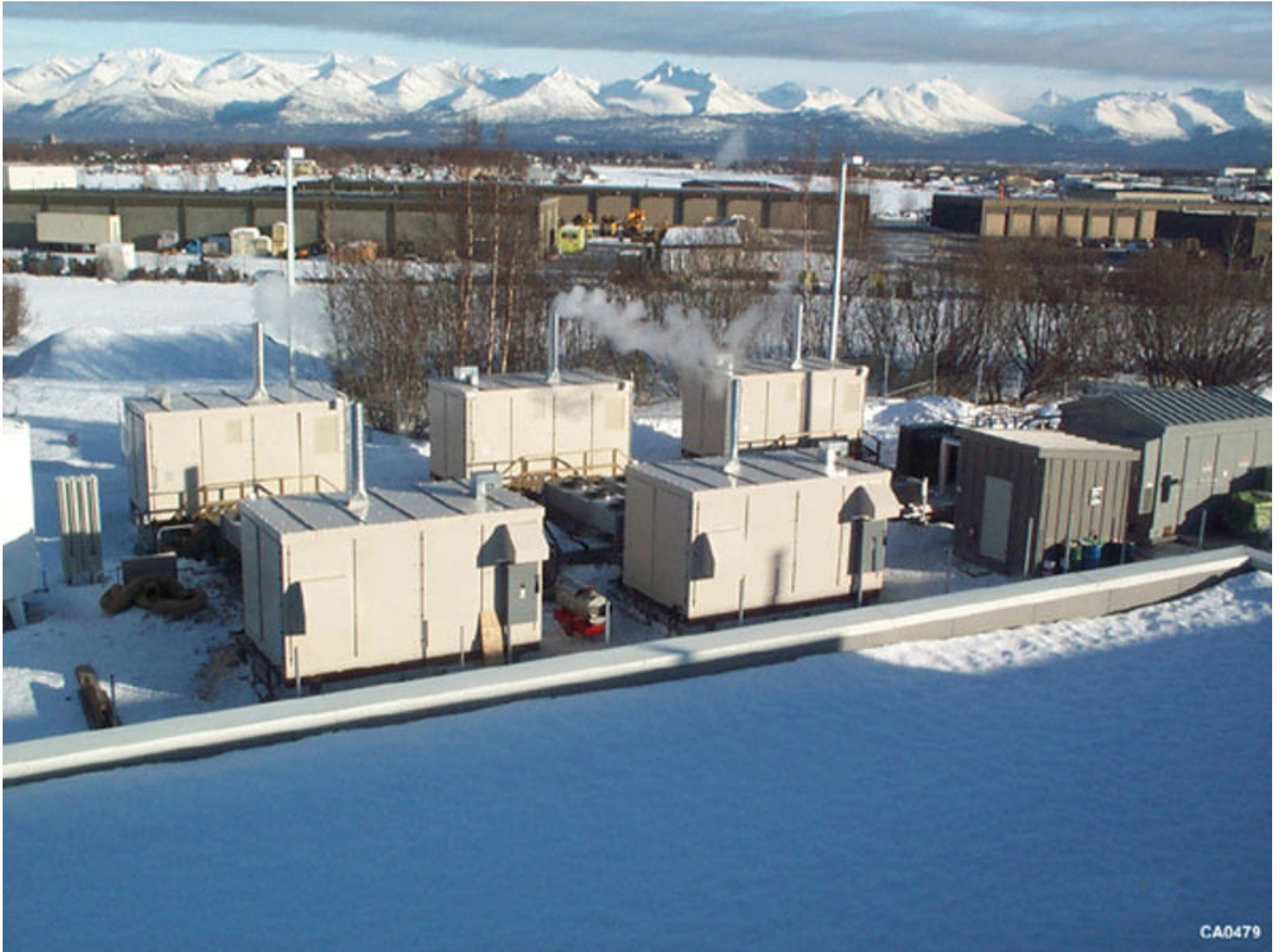
<u>Type</u>	<u>Efficiency</u>	<u>Operating Temp.</u>
Solid Oxide	45-65%	800°C
Molten Carbonate	50%	650°C
Phosphoric Acid	40%	200°C
Alkaline	50-60%	80°C
<i>Direct Methanol</i>	40%	80°C
<i>Proton Exchange Membrane (PEM)</i>	40%	50°C



Power Generation

PAFC

- IFC now UTC Fuel Cells
- First units in South America, China
- Multi-unit installations
 - ◆ Long Island (7)
 - ◆ Connecticut (6)
 - ◆ Alaska (5)
- ~250 units installed



MCFC

- FCE units installed
- Hybrid Unit (Capstone) begins Operation
- Partnerships
 - ◆ MWH : waste treatment plants
 - ◆ Marubeni: Japan
 - ◆ Caterpillar: DG up to 3 MW

Alkaline

- Apollo Energy Systems (FL) Announces \$223 M Sale
 - ◆ 2,000 10kw units per month for backup power
 - ◆ Purchaser is Hydrolec, Inc.

PEM

- 500+ units operating in the field
- Companies arranging for access to market
- Specialty applications sought





PEM

■ Idatech

- ◆ Installing (with Bonneville Power) 3 KW residential units in 4 NW states

■ Plug Power

- ◆ In-home unit operating W. NY
- ◆ 57-unit test on Long Island



PEM

■ Nuvera

- ◆ Demonstration at Verison facility; grid is backup

■ Avista

- ◆ New business relationships reach out to backup power, remote rail applications
- ◆ Unit operating at Army National Guard facility
- ◆ Hybrid research with Maxwell ultracap.

SOFC

- Siemens Westinghouse breaks ground on 430,000 s.f. manufacturing facility
- 220 kw SOFC-gas turbine hybrid operating in CA
- SCAQMD selects Fuel Cell Technologies Ltd. For residential test

Portable Power

- Marketplace eagerly awaiting Coleman Powermate Unit
- Major companies pursuing battery replacements
 - ◆ Motorola, Panasonic
- DOT reviewing common carrier regulation
 - ◆ Rescinded permission for charged hydride shipment

Government -- States

- California Fuel Cell Partnership
 - ◆ 16 cars committed
 - ◆ Methanol station in operation
 - ◆ Study: H₂ and Methanol options viable
 - ◆ Bus program lagging (3 buses on order)
- California Fuel Cell Collaborative
- Cal Power Authority RFB
 - ◆ Offers of energy at 13-15 cents/kwh

Government -- States

- Aggressive programs in Michigan (NextEnergy), Ohio
- Lobbying effort under way in Texas & NJ
- Connecticut Clean Energy Fund major purchaser of f.c.'s (25+ units)
- Other Public Benefit Funds looking for guidance

Government -- Federal

- President's Energy Plan includes fuel cells and hydrogen
- Congress requires report/plan
- DOE reorganization brings together 2 of 3 fuel cell programs and hydrogen
- FreedomCAR announced
 - ◆ \$150 M in first year, half in f.c.'s and hydrogen

Government -- Federal

■ SECA

- ◆ Goal: \$400/KW
- ◆ Major developers announced
 - ◆ Honeywell, Siemens Westinghouse, Delphi + Battelle, Cummins + McDermott
- ◆ Solicitation for 10-year \$350 M effort open through January 2003

Transportation

GM AUTONOMY

Rethinking the Automobile

- Will run on Hydrogen
- 5 person drivable version due end of 2002



- 6 inch thick "Skateboard" Chassis lasts 10 –20 years, fits wide range of 'bodies'



Fuel Cell Vehicles:



- Daimler Chrysler
NECAR 5
- Mercedes A-Class
- Ballard 75kW fuel
cell / Methanol
- 280 mile range
- 90 mph top speed
- Endurance
Record: San
Francisco to DC

Fuel Cell Vehicles:

- Ford Focus FCV

- Averaged 65 mph in 24-hour endurance test

- Ballard 75 kW fuel cell/Compressed H₂

- 100 mile range

- 80 mph top speed

- Fleet Introduction in CA in 2004



Ford Focus

Fuel Cell Vehicles:



- GM's Chevy S-10 FC Pickup
- First gasoline reforming FCV



Fuel Cell Vehicles:

- Honda's FCX-V4

- Ballard Fuel Cell w/ Ultra Capacitors

- 185 mile Range

- 5,000 psi Compressed Hydrogen

- City of Torrance (south of LA) will acquire Honda's First Fleet Demonstration Vehicles (<20) in 2003

- Honda and Plug Power to develop home-based hydrogen refueling stations (May 2002)



Fuel Cell SUVs:



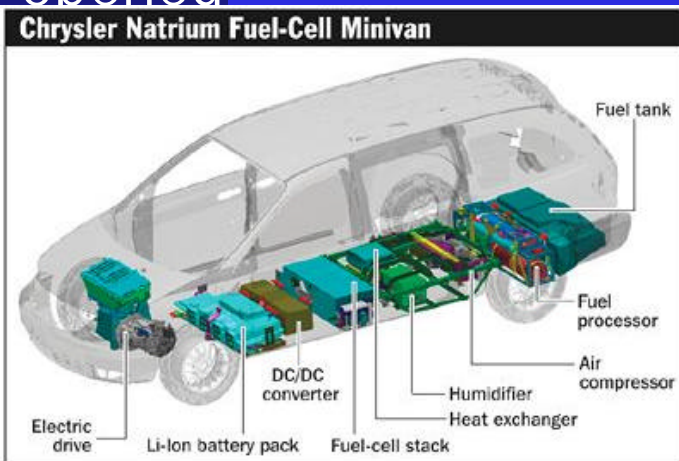
- Toyota's FCHV-4
- Claims 3x energy efficiency
- Uses 90 kW Toyota PEM Fuel Cell
- 155 mile range
- 95 mph top speed
- Uses Compressed Hydrogen
- 30 –50 units in Japan in 2003 for US\$75,000

Fuel Storage:



- Quantum Technologies and Lincoln Composites demonstrate 10,000 psi H₂ tank

- Powerball Technologies: sodium hydride stored in plastic balls; react with water once opened



- Millennium Cell system: non-flammable Sodium Borohydride and catalyst.

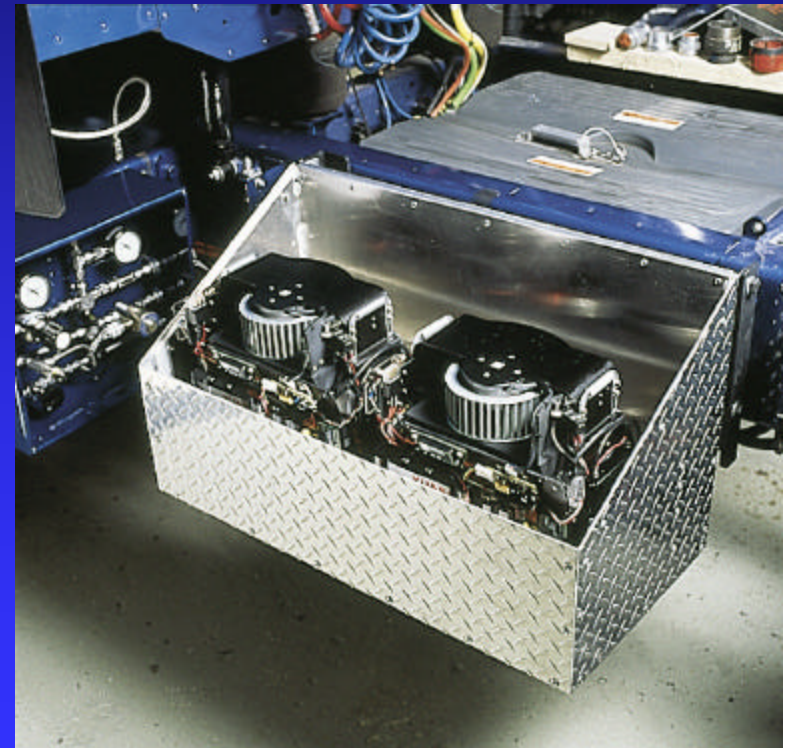
Fuel Cell Buses:



- GEF/UNDP Fuel Cell Bus Project in: Beijing, Cairo, Mexico City, New Delhi, Sao Paulo, and Shanghai (2003 or 2004)
- CUTE/ECTOS: 30 Fuel Cell Citaros in 10 cities (2003)
- Berlin, Copenhagen, Lisbon Project (2003)
- Georgetown University
- California Fuel Cell Partnership

Auxiliary Power Units:

Freightliner

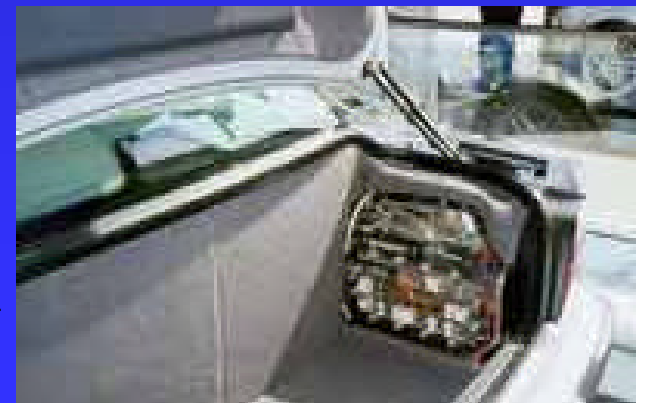


Fuel Cell APUs:



BMW 7-Series

UTC 5 kW APU



Specialty Vehicles:



Aprilia (2002)

- PM pollution from a typical motor scooter is almost as high as that from a large diesel truck per mile; carbon monoxide and hydrocarbons emissions is triple
- Scooters (50-150cc) will remain a primary transportation mode in Asia

Specialty Vehicles:



MHTX/Aprilia

Time's Invention
of the Year for
2001

www.usfcc.com

Anthony A. Androsky
Deputy Executive Director
US Fuel Cell Council
1625 K Street, NW, Suite 725
Washington, DC 20006
202.293.5500 ext-15