

EPA Climate Technology Initiatives Conference

October 10 - 11, 2007

Baltimore, MD



www.advancedenergy.org

▶ Climate Technology Initiative Conference

▶ Who we are

- > North Carolina non-profit with Public Benefits Funding but with nearly equal portion of revenues deriving from nation wide work
- > We work to improve the return on energy investments in residential, commercial, and industrial markets
- > We focus on motors and drives, process heating, building construction, and renewable generation (through our subsidiary, NC GreenPower)

▶ Climate Technology Initiative Conference

▶ Mission

- > To create economic, environmental, and societal benefits through market based and innovative approaches to energy.



▶ Climate Technology Initiative Conference

▶ Focus of this presentation

- 1) Technologies that can significantly reduce CO2 emissions,
- 2) Technologies in which Advanced Energy has been involved in,
and
- 3) Technologies that might be accelerated in the market place by
some action of EPA such as labeling.

▶ Climate Technology Initiative Conference

- ▶ Further break down of these technologies into two major categories
 - A. Technologies with market presence which may become more widespread with EPA labeling.
 - 1) Variable speed pool pumps
 - B. Technologies that are emerging in the market place which could become eligible for labeling upon their commercialization and proven operation.
 - 1) Hybrid plug-in school buses
 - 2) Large scale PV solar tracking concentrator units
 - 3) Fuel cells

▶ Climate Technology Initiative Conference

▶ One suggested approach for EPA labeling

- > Under the assumption that one would expect steady improvements in efficiency, reliability, and costs for emerging technologies, then a tiered rating system might make sense.
 - Silver
 - Gold
 - Platinum
- > Such a plan would require EPA to conduct annual or biannual recertification of the selected technologies depending on the speed of change or the advancement of the art of the particular technology.

▶ Climate Technology Initiative Conference

▶ Variable Speed Pool Pumps

Estimated savings from converting pumps for approximately 5,000,000 in-ground pools to variable speed.

- National
 - 8,434 MW peak demand
 - 9,466 GWh annually
- Per Unit
 - 1.54 kW¹
 - 2,000 kWh annually¹

> 1.9 million tons of Coal avoided annually²

> 7.2 million tons of CO² avoided annually²

¹ Calculated by utility using DEER methodology

² Calculated using national average fuel mix 62% coal



 **Pentair Water**
Pool and Spa®

Sanford, NC

▶ Climate Technology Initiative Conference

▶ Variable speed pool pump incentive programs

- > SCE*
- > PG&E*
- > SDG&E
- > Various CA Municipalities
- > Austin Energy
- > Nevada Power*

* Offer third-party outsourced programs



▶ Hybrid Plug-In Electric School Buses

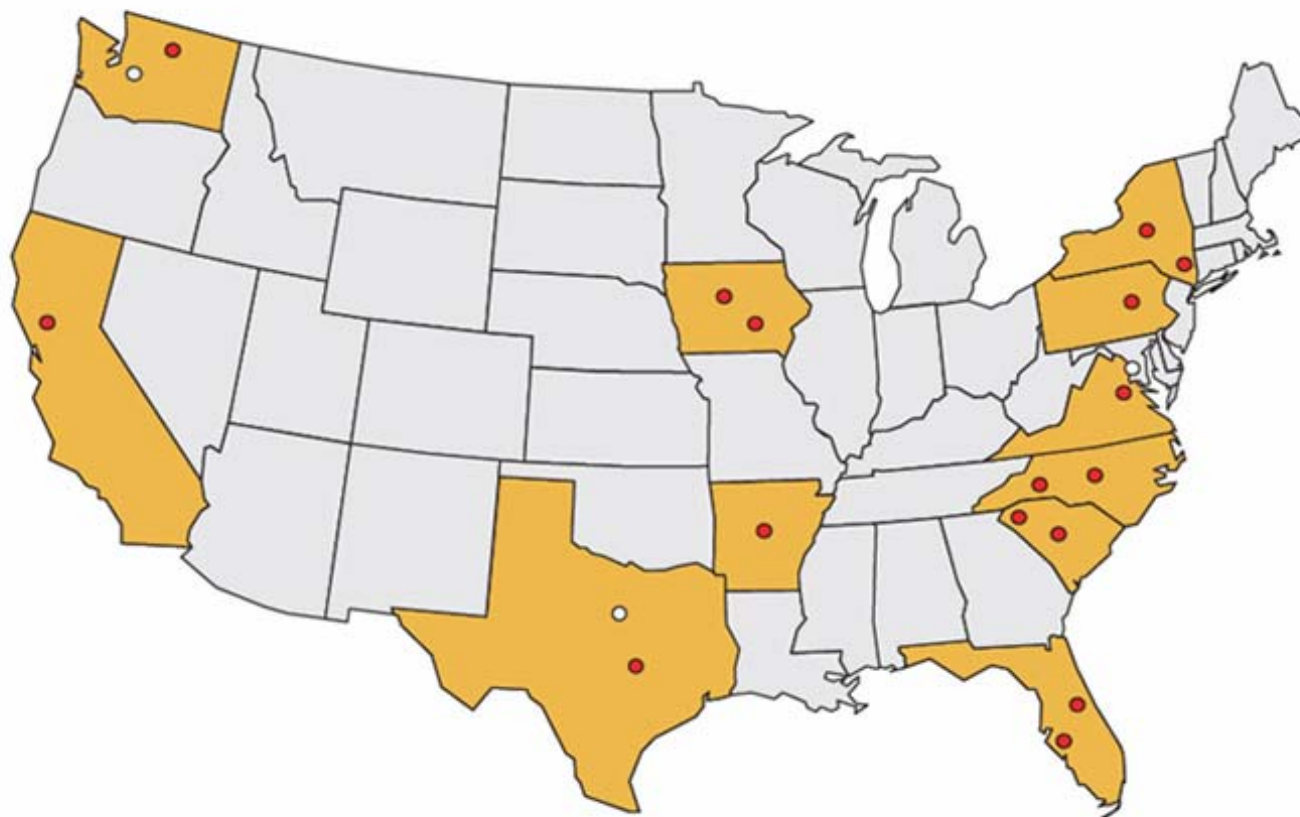
▶ Facts

- > Initiated by Advanced Energy in 2002
- > The most viable plug-in platform to commercialize at the time
- > Available for purchase today
- > Built by International Corporation
- > Lifecycle savings expected in full production volumes
- > EPA helped many districts with Clean School Bus USA funds



▶ Hybrid Electric School Buses

▶ 19 buses in 11 States



- ▶ North Carolina (2)
- ▶ South Carolina (2)
- ▶ Florida (2)
- ▶ Virginia (1)
- ▶ Washington DC (1)
- ▶ Pennsylvania (1)
- ▶ New York (2)
- ▶ Arkansas (1)
- ▶ Iowa (2)
- ▶ Washington (2)
- ▶ California (1)
- ▶ Texas (2)

▶ Hybrid Electric School Buses

- ▶ 50-100% estimated improvement in fuel economy
- ▶ ~30% carbon reduction when recharged with normal power generation



▶ Solar Energy – MegaWatt Solar

- ▶ Concentrating
- ▶ 2 axis tracking
- ▶ Based in Hillsborough, NC
- ▶ Motto
 - > “Solar without subsidies”
- ▶ Production costs significantly lower than existing solar
- ▶ 3.5 kW test unit operating



Current “Plate & Frame” Technology Fuel Cell Stack

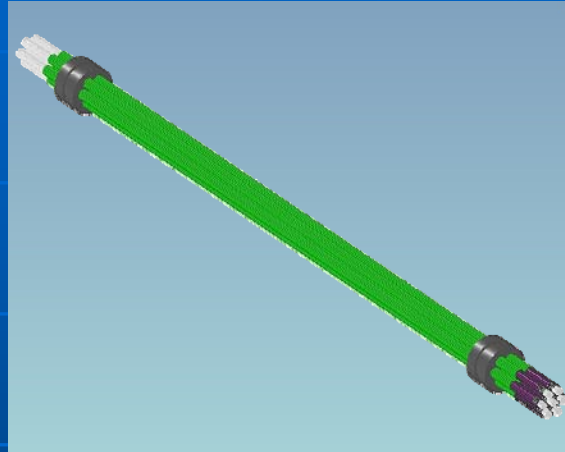


How is Microcell's fuel cell
different?

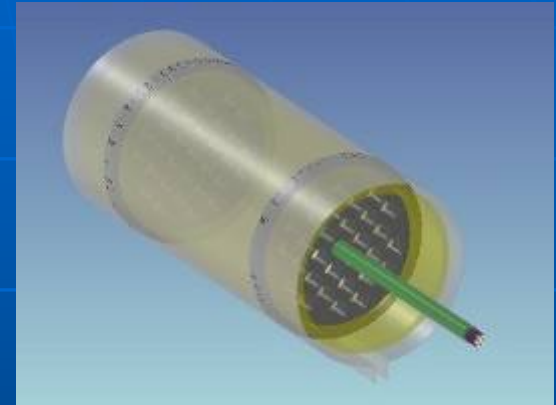
Technology – Microcell Assembly



- 1-1.5 Watts per cell
- Mass produced on high speed extrusion line



- Replaceable Unicell (10-15W)
- Fuel, air and thermal management incorporated
- Inserted into module and sealed
- About the size of a pencil



- Building block for larger systems (25 or 50kW)
- Currently 1-2kW module is 4" in diameter and contains 120 Unicells
- Separate chambers to feed fuel, air and coolant
- End caps contain "quick connect" electrical connections

Significant Competitive Advantages

Lower Production Cost

- Continuous automated extrusion process
- Derived from raw materials compared to purchasing components
- Elimination of expensive bipolar flow field plates
- Reduced auxiliary and control equipment requirements; no humidification equipment
- Simplified design and fabrication processes = lower labor costs

High Power Density

- Simplified design and no humidification system = compact and lightweight
- Cylindrical shape provides the ideal fibrous geometry, resulting in the highest possible surface area / volume ratio
- Power density results exceed 1kW/L

Ease of Repair, Serviceability

- Individual Microcell cores are inserted into a fuel cell module
- Individual cores can be replaced without replacing the entire module

High Thermal Efficiency

- Heat removal occurs from every inch of every single cell
- Design allows for optimal heat removal to reduce cell degradation

Quick Start Operation

- Metallic current collectors heat up much faster than graphite plates
- Reach operating temperature quickly; essential for operating effectively in cold weather conditions

▶ Supporting Climate Technology Initiatives

- ▶ These are just some examples of the emerging technologies. We believe they hold much promise.
- ▶ A tiered EPA labeling system with periodic review in each relative field would help us better evaluate these technologies and serve as an important marketing tool upon their commercialization and documented results.

Robert Koger, PhD
President and Executive Director

919 857-9000

bkoger@advancedenergy.org



www.advancedenergy.org