



Delaware County Electric
Cooperative, Inc.

A Touchstone Energy® Cooperative 
The power of human connections

Residential Fuel Cell Demonstration by the Delaware County Electric Cooperative, Inc.

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Delaware County Electric Cooperative, Inc.

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This presentation does not contain any proprietary or confidential information.

FCP17



- Headquarters: Delhi, NY
- Geographic Area Served:
 - Counties: Delaware, Schoharie, Otsego, Chenango
- 800 miles of distribution lines
- 5,000 member/customers
- 35 Employees
- System Load: ~15MW peak
- Member of National Rural Electric Cooperative Association (NRECA)



Vital Utility supplier to the Greater Catskill Mountain area



Timeline

- Congressional Earmark October 2003
- Project Started February 2004
- DOE Contract Finalized September 2004
- Project to be Completed January 2007
- Percent Complete 35%

Budget

- Total project funding \$637,000
- DOE share \$294,000
- Co-funding \$342,000
- FY04 DOE funding \$0
- FY05 DOE funding ~\$218,000

Majority of 2005 expenses relate to installation and commissioning.



DOE Technical Barriers for Fuel Cell Validation

- DOE designation “I”
- Hydrogen and electricity co-production
 - Cost and durability not statistically validated
 - Permitting, codes, and standards not established for fuel cells in or around buildings
 - Lack of operational and maintenance experience

Field experience required to overcome barriers.



Major funding:

- Department of Energy Golden Field Office
- New York State Energy Research and Development Authority (NYSERDA)
- National Rural Electric Cooperative Association (NRECA) / Cooperative Research Network (CRN)
- Energy Now! Inc.

Education and outreach:

- State University of New York College of Technology at Delhi (SUNY Delhi)
- NRECA / CRN

Technical contribution:

- Gaia Power Technologies, Inc.
- Sandia National Laboratories
- Mirabito Fuel Group
- New York Power Authority
- Plug Power, Inc.

Data analysis and reporting:

- EnerNex Inc.
- Energy Now! Inc.
- NRECA / CRN
- SUNY Delhi

Project team comprised of policy, technical, and outreach experts.



Demonstrate viability of grid-independent home

- typical upstate NY residence
- total electrical energy needs met by fuel cell
- intelligently managed energy storage
- in-home load control
- Increased efficiency through thermal recovery

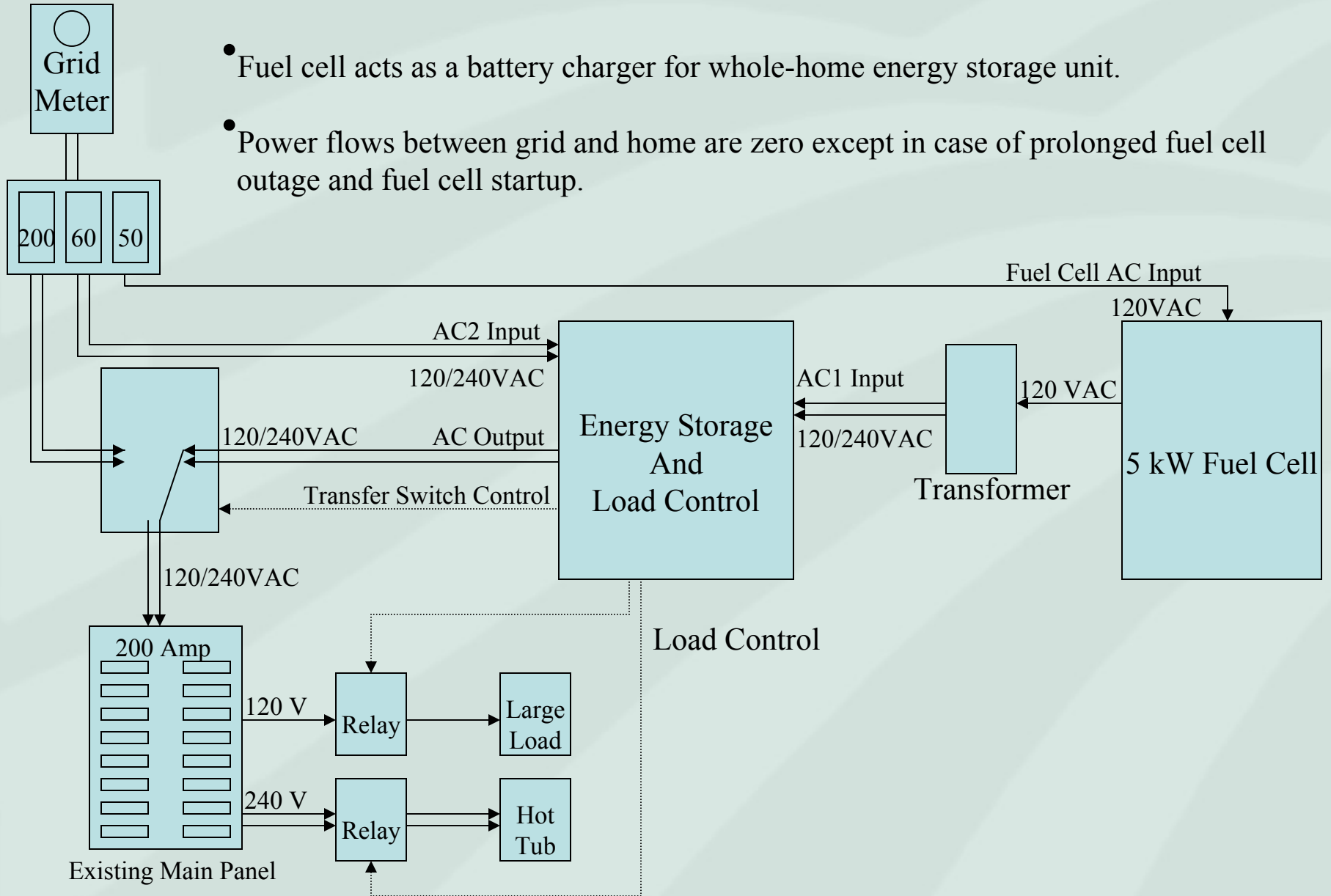
Validate objectives of propane fueled hydrogen fuel cells for edge-of-grid residences via a field trial demonstration

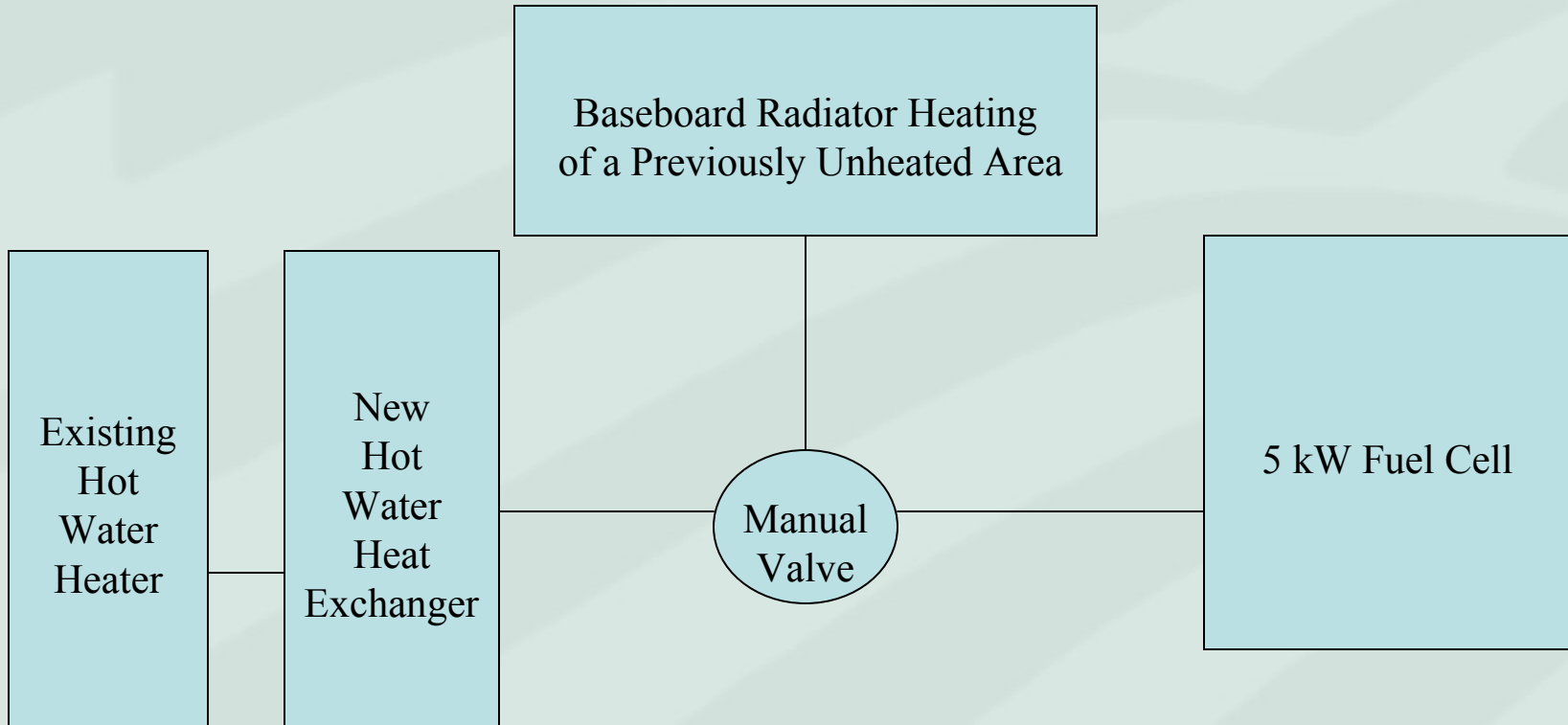
- measure and report technical performance
- provide raw cost data and economic viability analysis
- document maintenance and operations concept enhancements specific to residential fuel cells
- share safety related vulnerabilities analysis and lessons learned
- promote education of state and local consumers



Approach - Electrical

- Fuel cell acts as a battery charger for whole-home energy storage unit.
- Power flows between grid and home are zero except in case of prolonged fuel cell outage and fuel cell startup.



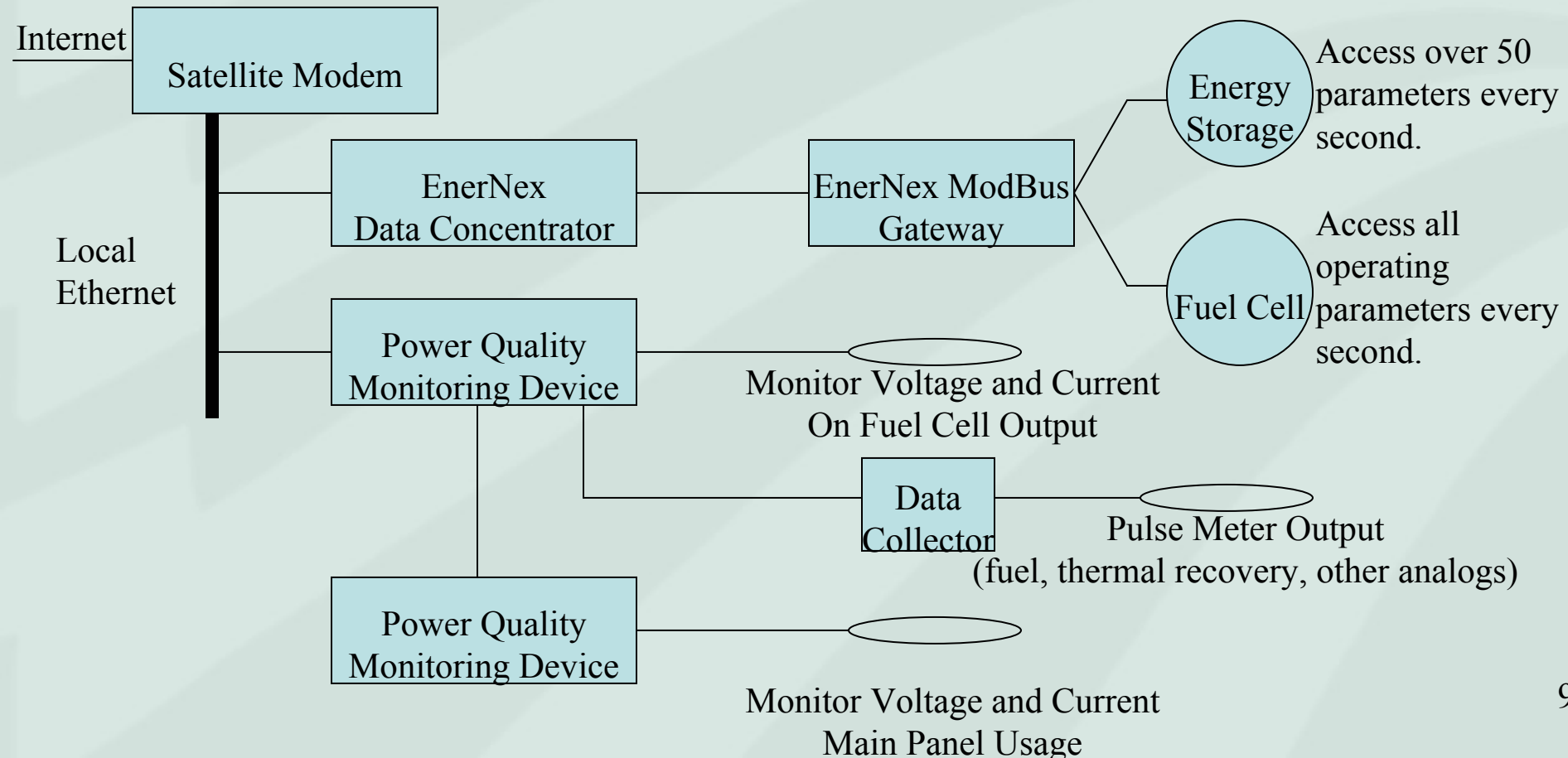


- Summertime hot water pre-heating
- Winter time space heating through baseboard radiators



Approach – Data Monitoring

- 5 months of baseline electric load recording accomplished with standard on-site recording device
- Real-time Web access to all technical performance parameters to be provided
- Power quality events recorded with 1 millisecond periodicity





- Avg. Energy use per day: 47.6 kWh
- Max. Energy Usage in 1 day: 67 kWh
- Avg. power draw: 1.98 kW
- Max. power draw: 15.2 kW
- (1 minute data sampling)





- Summer 2005 press event with participation by state and national representatives
- Case study materials professionally printed in color glossy for distribution to press, schools, local colleges, and other rural electric cooperatives around the county
- One-day fuel cell seminar jointly hosted by project team, State University of New York at Delhi, and Sandia National Labs
- Presentations to state, regional, and national rural electric cooperative associations
- Technology transfer program facilitated by National Rural Electric Cooperative Association – Cooperative Research Network



- Project team formation
- Stakeholder definition and communications
- Project plan, schedule, and budget formulated
- DOE contract finalized on September 23, 2004



- Completed contracts or memorandum of understanding with major project partners (Energy Now!, Gaia Power Technologies, Plug Power, NYSERDA)
- Site selected and host agreement finalized
- 1-minute residential baseline load data collected starting December 17, 2004
- Preliminary design complete for electrical, thermal, water supply, fuel supply, and site plan
- Awarded \$48,000 additional co-funding from NYSERDA to support energy storage portion of project
- DCEC employees trained to install, commission, and maintain fuel cells
- Pre-installation design review completed and installation started 5/9/05



- Tune house to the fuel cell environment
 - Major program objective is to work with a typical upstate NY residence and still demonstrate viability
 - Have added in-home load control as part of approach to enable the fuel cell to meet the total electrical energy needs of the residence
- Inadequate funding
 - DCEC has competed for and won an additional NYSERDA award to help meet the total financial needs of the project
 - DCEC has also applied for additional funding from the National Propane Education and Research Council and has received positive feedback on the proposal
- Need plan for educating the consumer
 - DCEC has developed a multi-pronged outreach approach that includes direct consumer education through public events and press contact, educational programs with local schools and colleges, and a national technology transfer program coordinated by the National Rural Electric Cooperative Association
- Work with a university program
 - DCEC has established a partnership with the State University of New York at Delhi
 - SUNY responsibilities include peer review, data analysis consulting, and co-teaching a fuel cell seminar with DCEC and Sandia Labs



- Complete installation in May
- Commissioning in June marks formal operating period
- Propane composition testing
- Emissions Testing
- Real-time monitoring and logging available via Internet
- Press event and public relations kick-off summer 2005
- Fall 2005 cut-over from hot water heating to space heating with recovered waste heat



- Spring 2006 cut-over from space heating to hot water heating with recovered waste heat
- Conclude fuel cell demonstration
- Collect additional baseline data of residence with energy storage without fuel cell to compare grid and fuel cell performance
- Data analysis and reporting
- Educational programs with SUNY College at Delhi
- Tech transfer program with the Cooperative Research Network of the National Rural Electric Cooperative Association



The remaining two slides are supplemental slides for
reviewer packets only.



No peer reviewed publications or presentations released to date



The most significant hydrogen hazard associated with this project is the possibility of Hydrogen leaking from the fuel cell's on-board reformer or the anode reformat supply to the fuel cell stack, which could result in a build-up of combustable gases in the fuel cell enclosure to the explosion point.

Our approach to deal with this hazard is to utilize the standard hardware emergency stop within the Plug Power GenSys 5P fuel cell design, which powers down the fuel cell in the event that combustable gas levels exceed $\frac{1}{4}$ of the explosion limit inside the fuel cell enclosure.