



***Fuel Cell Installation and  
Demonstration Project in Gallatin  
County, Montana***

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*"This presentation does not contain any proprietary or confidential information."*

The Demonstration Project is located on the 160 acre Galactic Park subdivision 7 miles west of Bozeman, Montana. Zoot Properties, LLC, a property holding limited liability company, owns the subdivision, headquarters building, fuel cells and other facilities identified in this report and is the "Cooperative Agreement" partner with the U. S. Department of Energy (DOE) on the federal grants for the project. Construction of the headquarters building began April, 2001 and it was occupied in September, 2002. It has a 55,000 square foot basement parking garage, two upper floors containing 100,000 square feet of office space and a 3,500 square foot computer data center. Zoot Enterprises, Inc., a financial services company, operations are located in the headquarters building. Zoot Enterprises customer demand is for "24-7" operation of the computer data center.

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- Demonstrate operation of a fully integrated distributed generation system consisting of a fuel cell generation plant, interconnection equipment and microgrid to provide the hydrogen industry and the general public with a high-technology real world application of such a system.
- Determine the degradation rate of the fuel cells and the point at which it becomes economically necessary to "restack" by essentially replacing the fuel cells themselves.

- Provide operational data to Montana State University to assist in the development of control equipment to optimize fuel cell performance when combined with other electrical sources.
- Maximize efficiency of the heat recovery (cogeneration) system.

- Install and begin operation of fuel cells and heat recovery system.
- Resolve technical issues relating to operation of fuel cells and heat recovery system and their integration into building systems.
- Resolve ownership and liability issues through creation of non-profit electrical cooperative.
- Establish legal relationship with NorthWestern Energy on interconnection, territory and price.
- Apply for financing from RUS/USDA.
- Firm timetable for installation of microgrid

- DOE Share: \$2,043,310
- Zoot Properties, LLC Share: \$2,230,276
- Total Project Funding: \$4,273,586
- DOE Funding in FY04: \$1,410,000

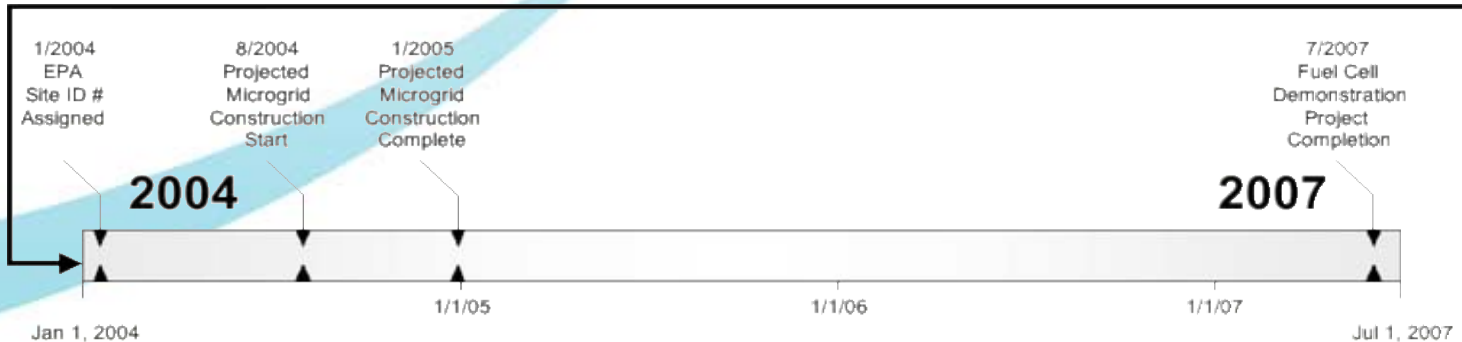
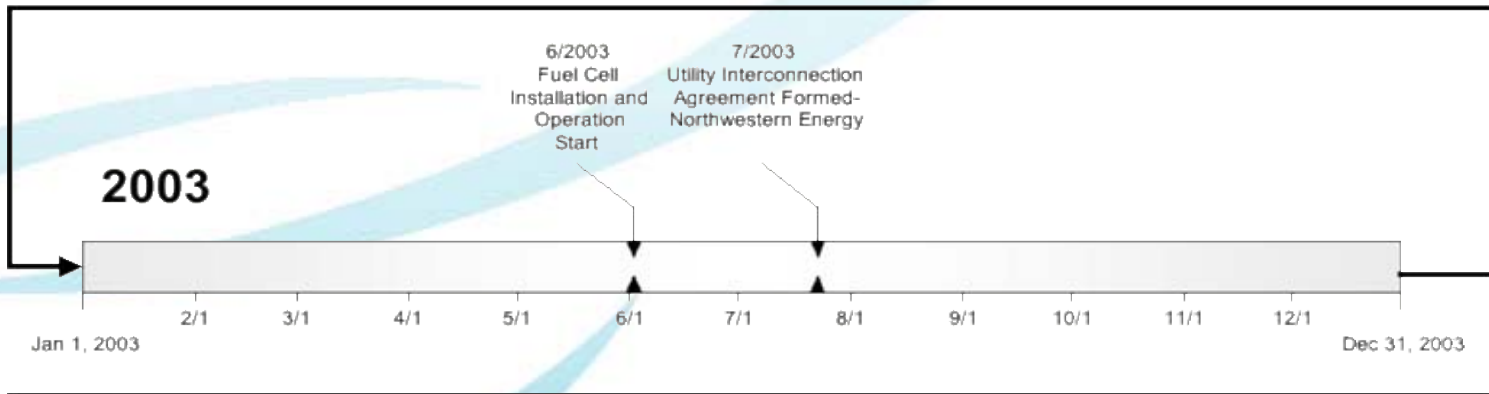
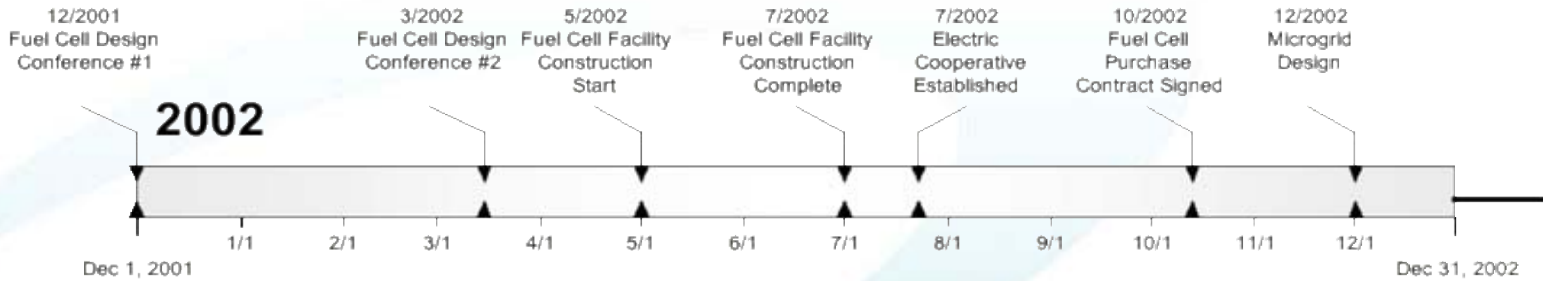
- Fuel Cells
  - Durability
  - Heat Utilization
  
- Technology
  - Hydrogen and Electricity Co-production
  
- Education
  - Lack of Demonstrations or Examples of Real World Use.



- Construct suitable fuel cell installation site at a high-tech facility.
- Install redundant stationary fuel cells.
- Install heat recovery system on fuel cells and integrate into building heating system.
- Operate fuel cells and heat recovery equipment according to manufacturing and engineering specifications as base load power supply and supplementary heat supply of building.

- Study/analyze performance and reliability of installed fuel cells, heat recovery equipment, interconnection equipment and microgrid based on operational data collection.
- Work in conjunction with Montana State University and others to enhance complimentary fuel cell and microgrid studies.





- The FuelCell Energy DFC 300 units comply with NFPA 853 standard 1.4.25 as "Fuel Cell Power Plant, Prepackaged, Self-Contained" reducing the on-site safety and fire compliance requirements. All safety warnings and recommendations in FuelCell Energy installation, maintenance and operations manuals observed.
- Interface modules were installed in the units connecting them to the facility fire alarm system.
- Headquarters and fuel cell service gear buildings constructed as seismic zone 3 "essential facilities."
- Compliance with all other applicable safety standards, including EPA, OSHA, NFPA 54-National Fuel Gas Code, NFPA 70-National Electrical Code and Montana State Building Codes.
- The DFC 300 "Direct Fuel Cells" do not require a direct hydrogen source allowing use of conventional natural gas supply.

## Installation and Operation of Two (2) 250 kW FuelCell Energy DFC-300 Molten Carbonate Fuel Cells



## Regulatory

- Completed Generation Interconnection Agreement with NorthWestern Energy to allow excess power not used by building to be transmitted back to electric utility grid.
- Completed a temporary compliance agreement with Belgrade Fire Marshall to operate fuel cells prior to installation of interface modules connecting the fuel cells to building fire alarm system. Later installed the interface modules.
- Obtained Environmental Protection Agency Site Identification Number to legally generate and dispose of possible hazardous waste produced by natural gas purification system.

## Operational

- Resolved, or in process of resolving, the following electrical integration issues between fuel cells and building:
  - Reconfigured fuel cells with neutral wire to make compatible with building system.
  - Rebalanced electrical bus load between the building's two (2) electrical buses and installed line reactors on large variable frequency drive motors to reduce harmonics adversely affecting building UPS systems. Load rebalance also helped meet minimum load requirements for fuel cell units.
  - Resolved voltage matching issue between fuel cells and building back up diesel generators.

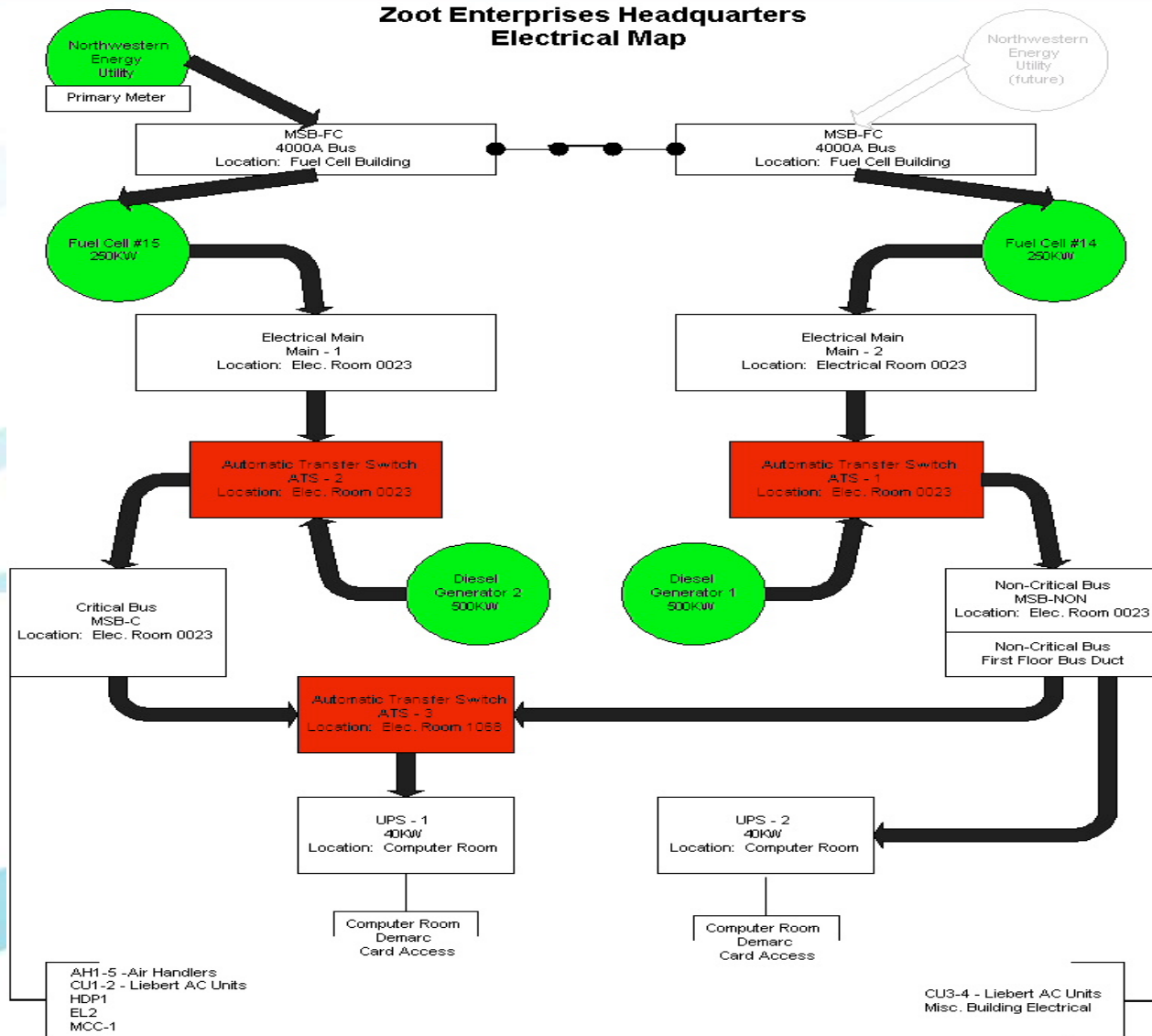




Fuel Cell  
Electrical  
Service  
Gear

## Operational

- No evidence of fuel cell degradation.
- Installed second back up diesel generator completing integrated building system of electrical redundancy including fuel cells, utility grid, diesel generators and UPS systems. With fuel cell and generator installed on building critical and non-critical electrical buses, five sources of power available to critical building functions.



## Operational

- Developed proposed solution utilizing independent load banks to meet new load stabilization operating parameters when the fuel cells operate in grid independent mode. Until solution implemented, fuel cells will not operate in grid independent "island mode."
- Identified relay coordination issue affecting unit's ability to automatically go into "island mode" operation when the utility grid is off line. Solution has been proposed and will be implemented when unit load stabilization equipment identified above is installed and "island mode" capability enabled.

## Operational

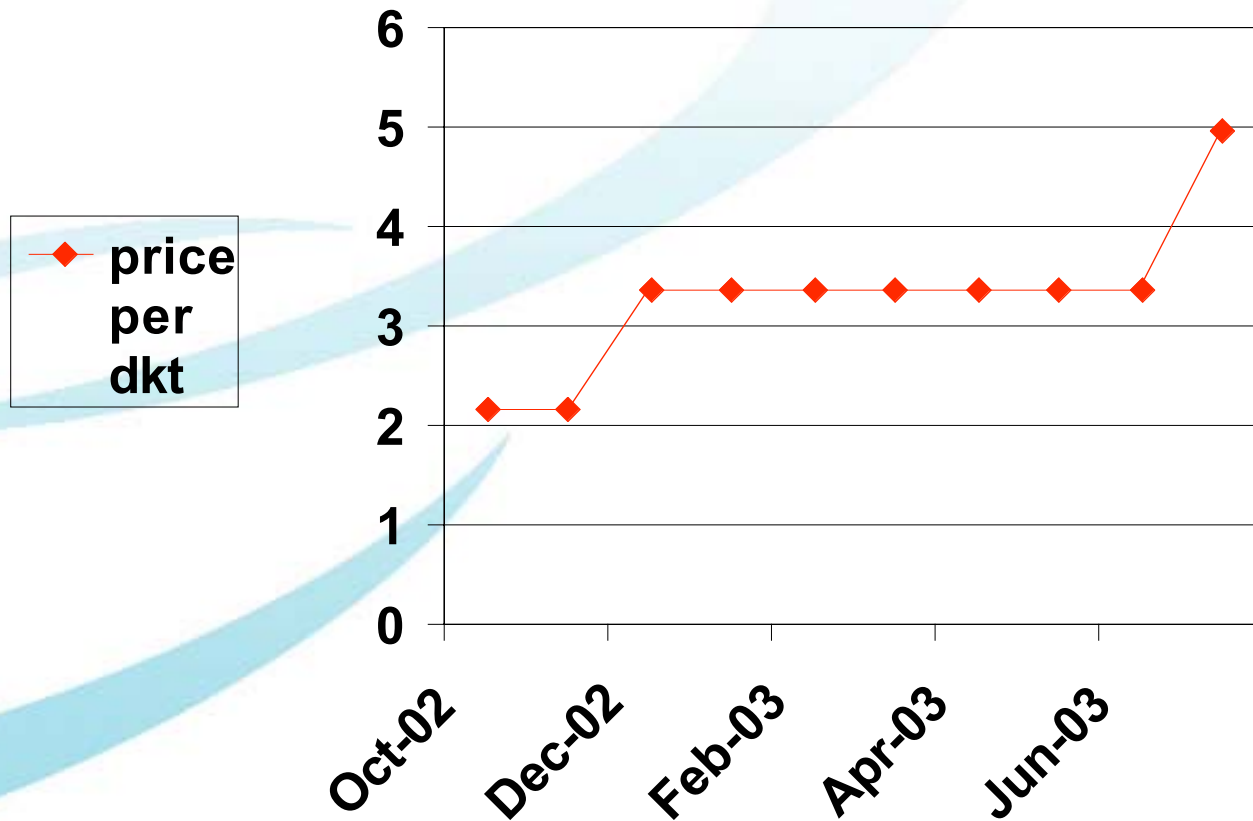
- Because temperatures at site can drop below  $-45^{\circ}$  F., alternative protection packages including construction of a building over the units and/or supplemental heaters are being considered to protect units if they go off-line in those conditions. Additional heating elements have been incorporated into units to help ensure proper operation in extreme cold.
- Determined that lower oxygen content in the atmosphere at site elevation of 4,687' above sea level adversely affects units power output.

Note: One fuel cell was off-line for repair from October 2003 – January 2004.

## Economic

- Because of natural gas price increases of 130% from facility occupancy in 2002 until fuel cell installation in 2003, negotiated separate natural gas supply and natural gas transportation contracts to assure price stability through first year fuel cell operation.
- Negotiated temporary agreement with NorthWestern Energy to price excess power transmitted back to utility grid at market rates. In process of negotiating net metering agreement with NorthWestern Energy to replace current market based rate agreement.

## Natural Gas Purchase Price



## Economic

- Fuel Cell Operation Resulted in:

Reduced building utilization of utility electrical grid 76.6% from an average of 118,200 kWh monthly to 27,600 kWh monthly.\*

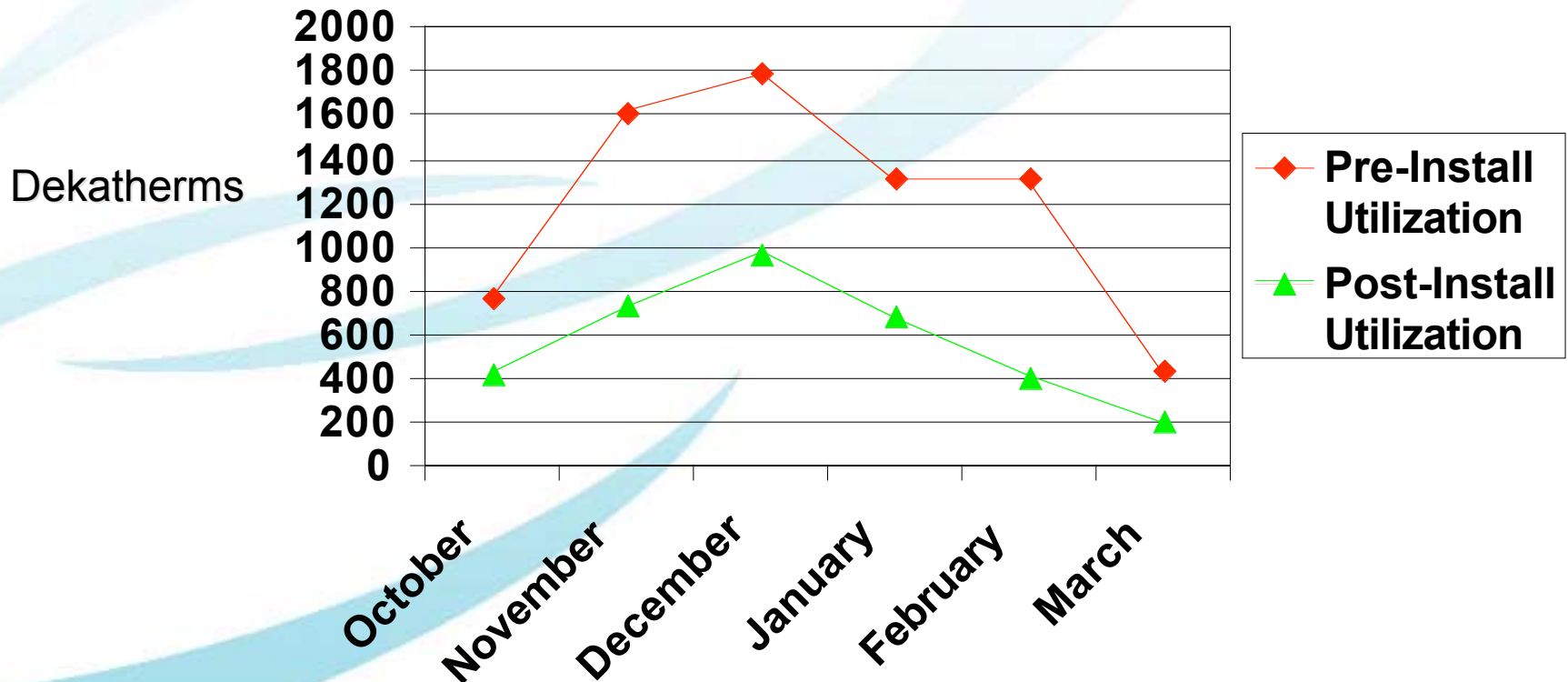
Reduced building utilization of natural gas for space and water heating 52.3% from 1,210 dekatherms monthly to 577 dekatherms monthly.\*

*\*Comparing 10/02-3/03 period, when building first occupied, to 10/03-3/04.*



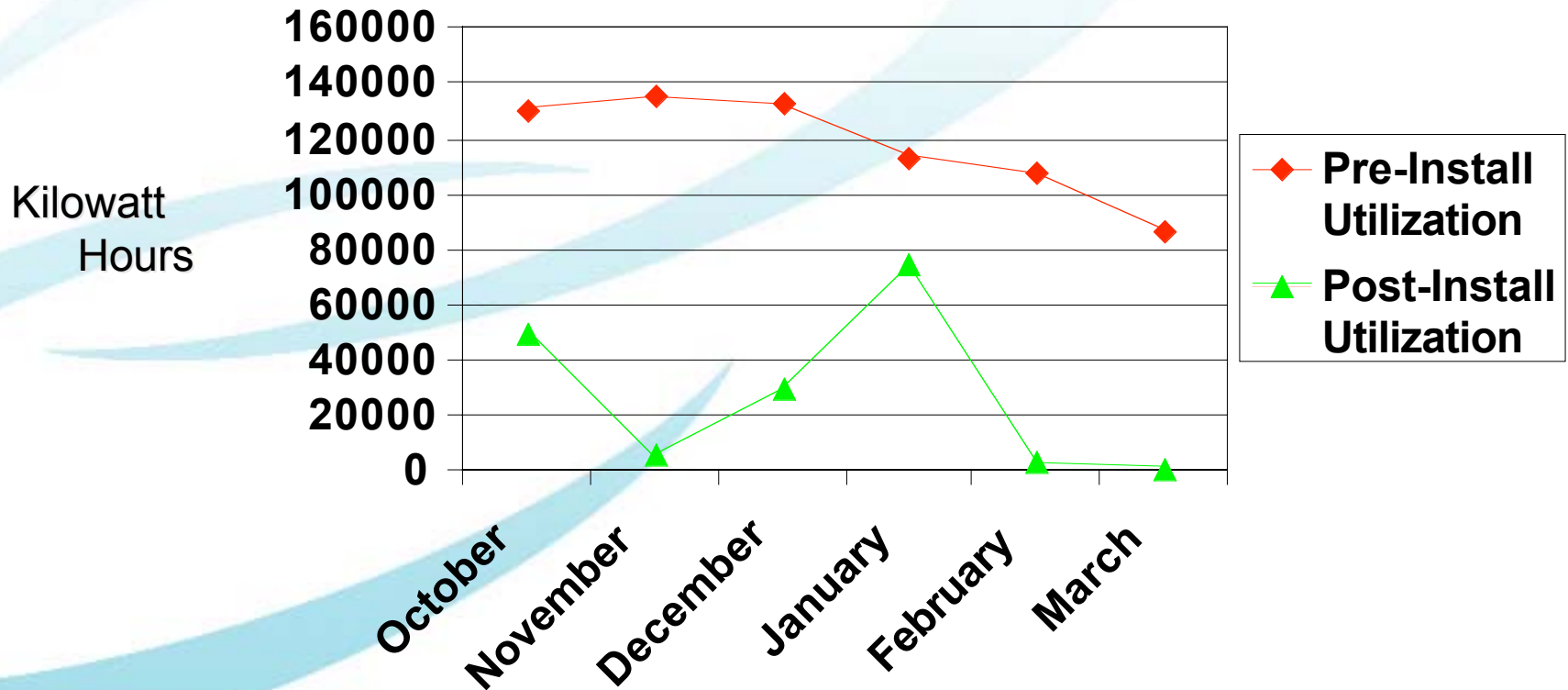
## Effects of Cogeneration

### Building Natural Gas Utilization



*\*Comparing 10/02-3/03 period, when building first occupied, to 10/03-3/04.*

## Effects of Fuel Cell Electrical Production Building Utility Grid Utilization



*\*Comparing 10/02-3/03 period, when building first occupied, to 10/03-3/04.*

## Economic

- Negotiations currently underway with manufacturer on an affordable, long term service agreement pending August, 2004 expiration of first year agreement.
- Current increases in copper and steel prices are adversely affecting the projected \$686,890 cost of the microgrid and interconnection equipment possibly jeopardizing their construction.

## Legal

- In 2002, Zoot Properties, LLC sold development rights on subdivision to New West Partners. Currently negotiating with New West Partners on start date for microgrid.
- Established non-profit Galactic Electric Power Cooperative, Inc. (GEPC) pursuant to Montana Rural Cooperative Utilities Act to serve as ownership and operating entity for complete distributed generation system.
- Negotiating agreement with NorthWestern Energy, pursuant to the Montana Territorial Integrity Act, to allow GEPC to legally sell power transmitted over the microgrid to customers in Galactic Park subdivision.

## Legal

- GEPC is applying to Rural Utilities Service/USDA for financing for private cost share obligation to project.
- Working with DOE on tripartite agreement transferring Cooperative Agreement obligations from Zoot Properties, LLC to GEPC.

- Working with Electrical Engineering Department at Montana State University on an ongoing basis. MSU is obtaining data from monitors on the fuel cells to use in the development of control systems to operate fuel cells more efficiently in multi-electrical source environments. MSU personnel have also participated in the design, testing and evaluation of the building electrical system and the design of equipment and systems to alleviate harmonics, balance loads and stabilize demand.

- Advised the City of Great Falls, Montana on fuel cell technology and it's application in city owned facilities.
- Participated in the DOE Cost Analysis for Small Cogeneration Systems study conducted by Energy and Environmental Analysis, Inc.
- Participated in DOE study of fuel cell installations conducted by Battelle Memorial Institute.
- Advised L.A. Olson & Associates, Inc. engineering firm of applicability of fuel cells to health care facilities on Indian Reservations in Montana.

- Presentation on the demonstration project to the Montana Joint Engineers Conference.
- Presentation on fuel cell and distributed energy applicability in Montana to the Montana Electric Cooperatives Association Board of Directors.
- Conducted tour of fuel cell installation for U.S. Environmental Protection Agency.
- Presentation on fuel cells and distributed generation to Burton K. Wheeler Center Conference on “Montana’s New Electrical Future.”



## Completion of Outstanding Operation / Integration Issues

- Implement load stabilization package and relay coordination solution to allow fuel cells to operate in grid independent "island mode." Fine tune operation of fuel cells.
  - May, 2004 for load stabilization package

## Completion of Outstanding Operation / Integration Issues

- Continued fine-tuning of fuel cell operation.
  - Ongoing
- Obtain approval from NorthWestern Energy to allow automatic re-closure of protective relay when fuel cell goes from grid independent “island mode” operation to grid connected operation.
  - Spring, 2004
- Implement decision on fuel cell protection package when off-line in cold weather.
  - Fall, 2004

## Completion of Outstanding Operation / Integration Issues

- Install microgrid and interconnection equipment and supply microgrid with excess fuel cell power.
  - Fall, 2004
- Fine tune operation of heat recovery system through installation of additional insulation, installation of flowmeter/BTU monitor and coordination with computerized building management system.
  - Ongoing



Fuel Cell  
Heat  
Recovery  
Unit (HRU)

## Completion of Legal Issues

- Complete Territorial Agreement with NorthWestern Energy.
  - May, 2004
  
- Complete Net-metering Agreement with NorthWestern Energy.
  - May, 2004
  
- Complete Tripartite Agreement with DOE transferring cooperative agreement obligations from Zoot Properties, LLC to GEPC.
  - May, 2004

## Economics

- “Keeping Project Affordable”
  - Ongoing
- Obtain RUS/USDA financing.
  - FY2004
- Complete service and operations agreement with manufacturer.
  - August, 2004
- Negotiate new contracts with natural gas supplier and natural gas transmission supplier.
  - August, 2004

## Demonstration Project Analysis

- Analysis of fuel cell and microgrid performance and reliability
  - Ongoing
- Continued collaboration with Montana State University and others.
  - Ongoing