# Zinc Bromine Flow Battery at Detroit Edison Utility Application

## California Energy Commission Workshop
## February 24, 2005

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DTE Energy®

# Agenda

- DTE Energy Background & Vision
- Detroit Edison Energy Storage Experience
- Asset Utilization & Economics

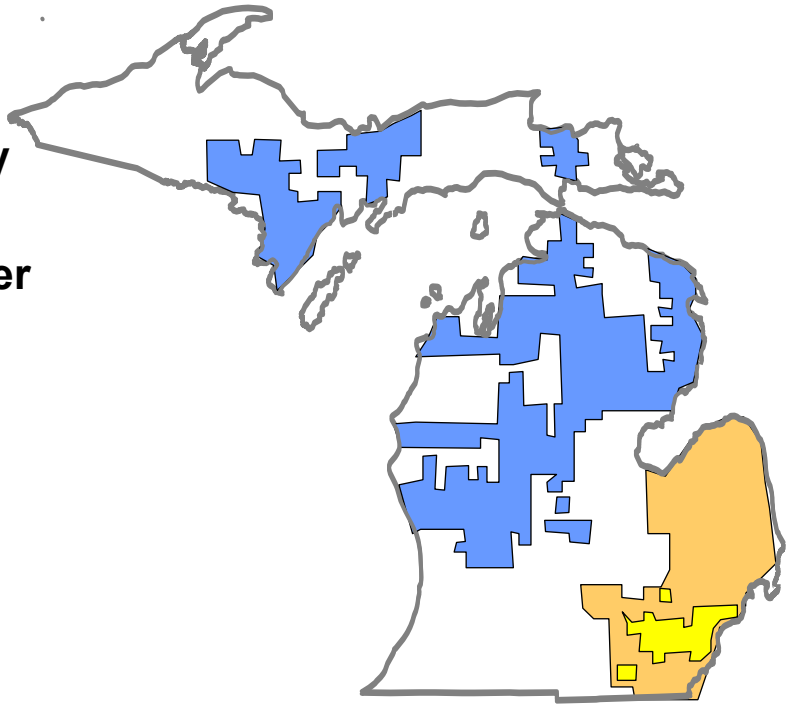
# Company Overview - DTE Energy

## Detroit Edison

- Seventh largest electric utility in the U.S. with 2.1 million customers
- Over 11,000 MW of power generation, primarily coal fired
- Fermi 2 nuclear plant is a top industry performer
- 54,000 GWh in electric sales
- ~$3.7 billion in revenue

## MichCon

- Fifth largest natural gas utility in the U.S. with1.2 million customers
- 170 Bcf of gas sales
- 12% of national gas storage capacity with 124 Bcf of regulated gas storage
- ~$1.5 billion in revenue



*Utility Service Territory*

Detroit Edison MichCon

Overlap

# Detroit Edison Service Area

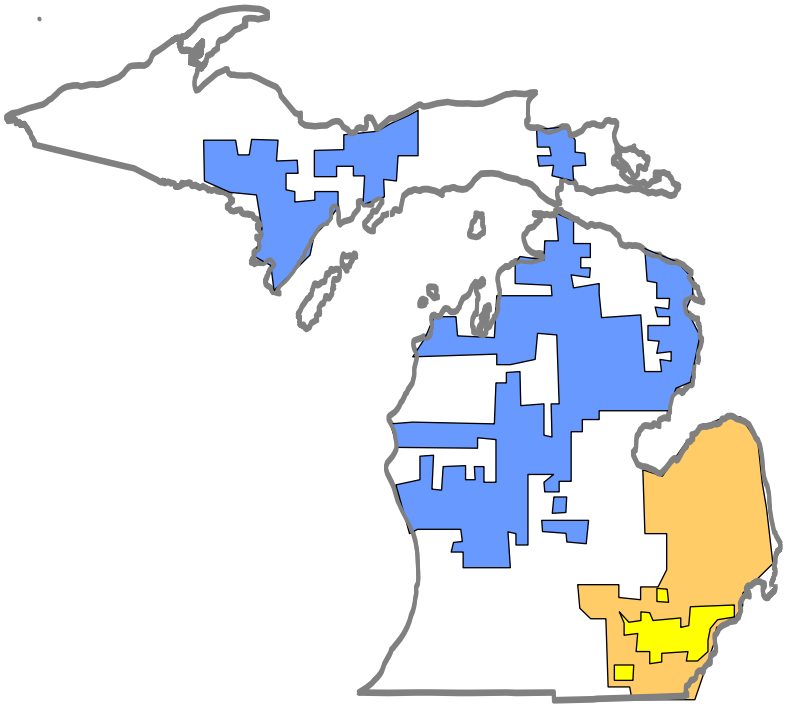
**Service Area: 7,600 Sq. Miles**

**Customers: 2.1 million**

**System Peak Load: 12,132 MW**
**Annual Sales: 56,000 GWH**

- 37% Commercial
- 29% Residential
- 29% Industrial
- 5% Wholesale & Interconnection

| | |
|---|---|
| **Distribution Substations** | **662** |
| **Distribution Circuits** | **2,808** |
| | **1,876 @ 4.8kV** |
| | **932 @ 13.2kV** |
| **Distribution Circuit Miles** | **38,939** |
| | **20,184 @ 4.8kV** |
| | **18,755 @ 13.2kV** |
| **Subtransmission** | **2,664 @ 41.6kV** |
| | **797 @ 24 kV** |



***Utility Service Territory***

**Detroit Edison** **MichCon**

**Overlap**

# DTE's Vision for Distributed Energy Resource

**Traditional Electric System**

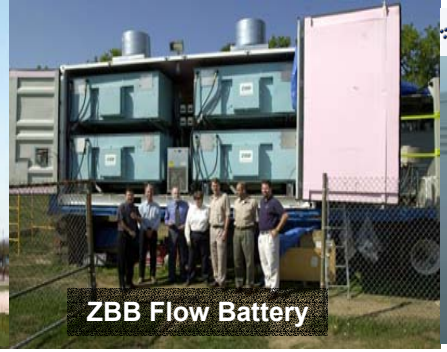

**Traditional Electric System**
**+**
**Distributed Energy Resource**

Just another tool!

# Distributed Generation at DTE Energy

## *Technology Testing*


Southfield Solar & Future H Power Park


ZBB Flow Battery

Substation Battery Replacement Project

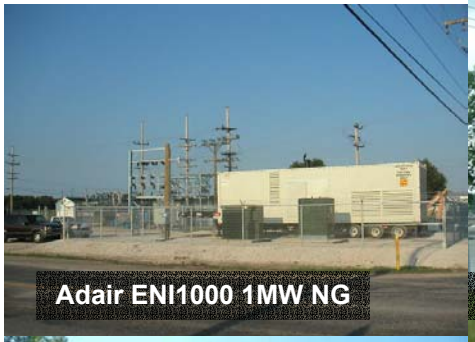
**Substation Applications**

Temporary & Maintenance

***Distribution Solutions***

**Circuit Applications**

Emergency & Temporary


Adair ENI1000 1MW NG


Union Lk ENR2000 2MW Diesel


Substation Islanding ENR2000 2MW Diesel


Emergency ENR2000 2MW Diesel

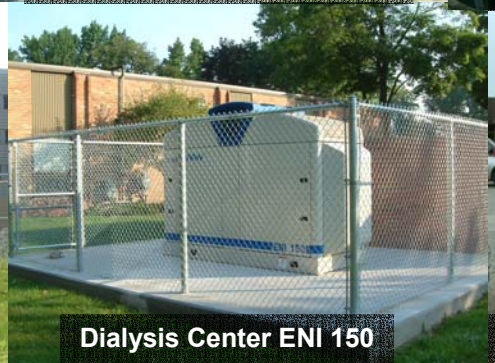

Grosse Ile High School ENI1000 1MW NG


Assumption Church ENI1000 1MW NG

***Premium Power***

**Customer Partnership Applications**


Wayne State Univ ENI 75


Dialysis Center ENI 150

Service Center ENI 150 & 75

# Agenda

- DTE Energy Background & Vision
- **Detroit Edison Energy Storage Experience**
- Asset Utilization & Economics

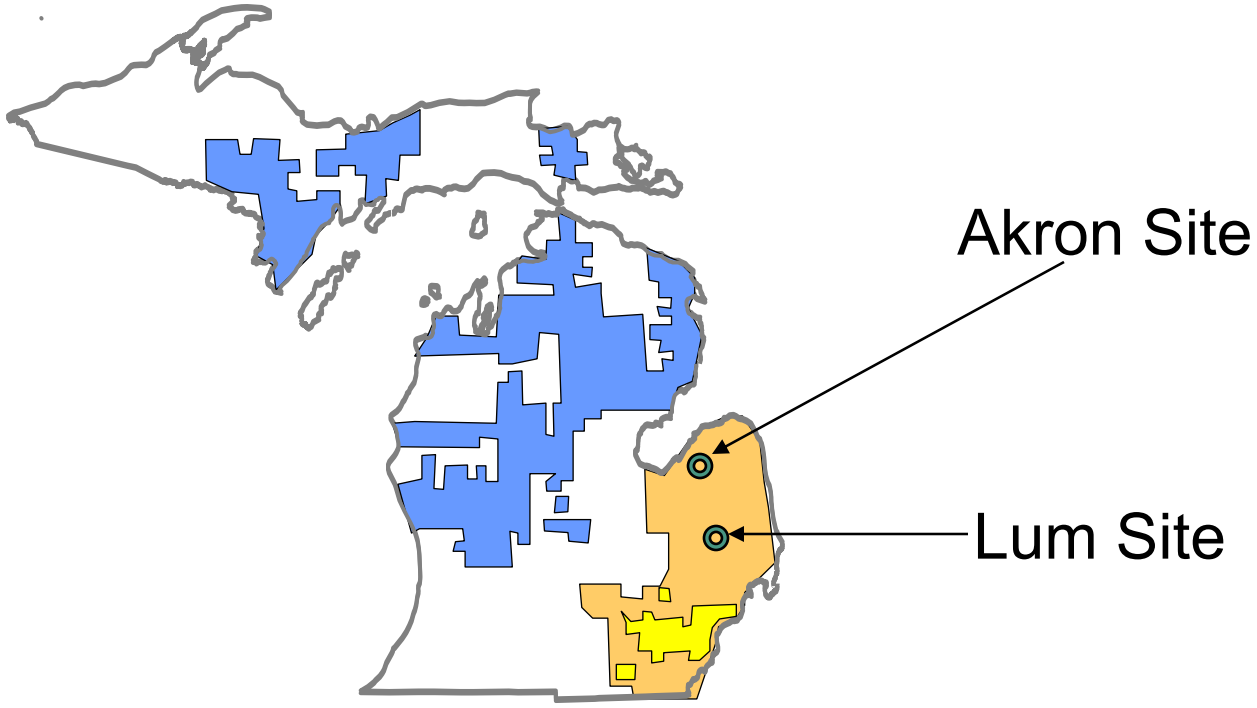
# Project Contributors

- US DOE Office of Power Technologies
  - Energy Storage Program (Funding)
- Sandia National Laboratories
  - Cost shared contract
- The Detroit Edison Company
  - Test sites, transformer, data collection
- SatCon Power Systems Canada, Ltd
  - Power conversion system
- ZBB Energy Corporation
  - Battery system

# Program Goals

- To manufacture a 400 kWh Zinc/Bromine ABESS
- To test battery system at two utility sites
  - Site 1 - Fall 2000
    - Power quality application, Akron, Michigan
  - Site 2 - Summer 2001 - 03
    - Peak shaving, Lum, Michigan

# Energy Storage Sites




*Utility Service Territory*

Detroit Edison MichCon

Overlap

# 50 kWh Battery Module

- 50 kWh (150 A, 30oC)
- 120 to 0 V DC
- 0 to 300 amps discharge
- 2 to 10 hour discharge
- 8’ x 3’ x 3’
- Approx. 3,000 lbs

# 400 kWh ABESS Characteristics

- 400 kWh Capacity
- Two independent strings
- 480 to 0 V DC
- 0 to 300 amp discharge per string
- 2 to 10 hour discharge
- 20’ x 8’ x 9’6”
- Approx. 40,000 lbs

# Power Conditioning System Characteristics


- 200kW/250kVA
- Grid connected or stand alone
- 480 or 400V AC, 3 phase
- 50 or 60 Hz
- Full four quadrant power control

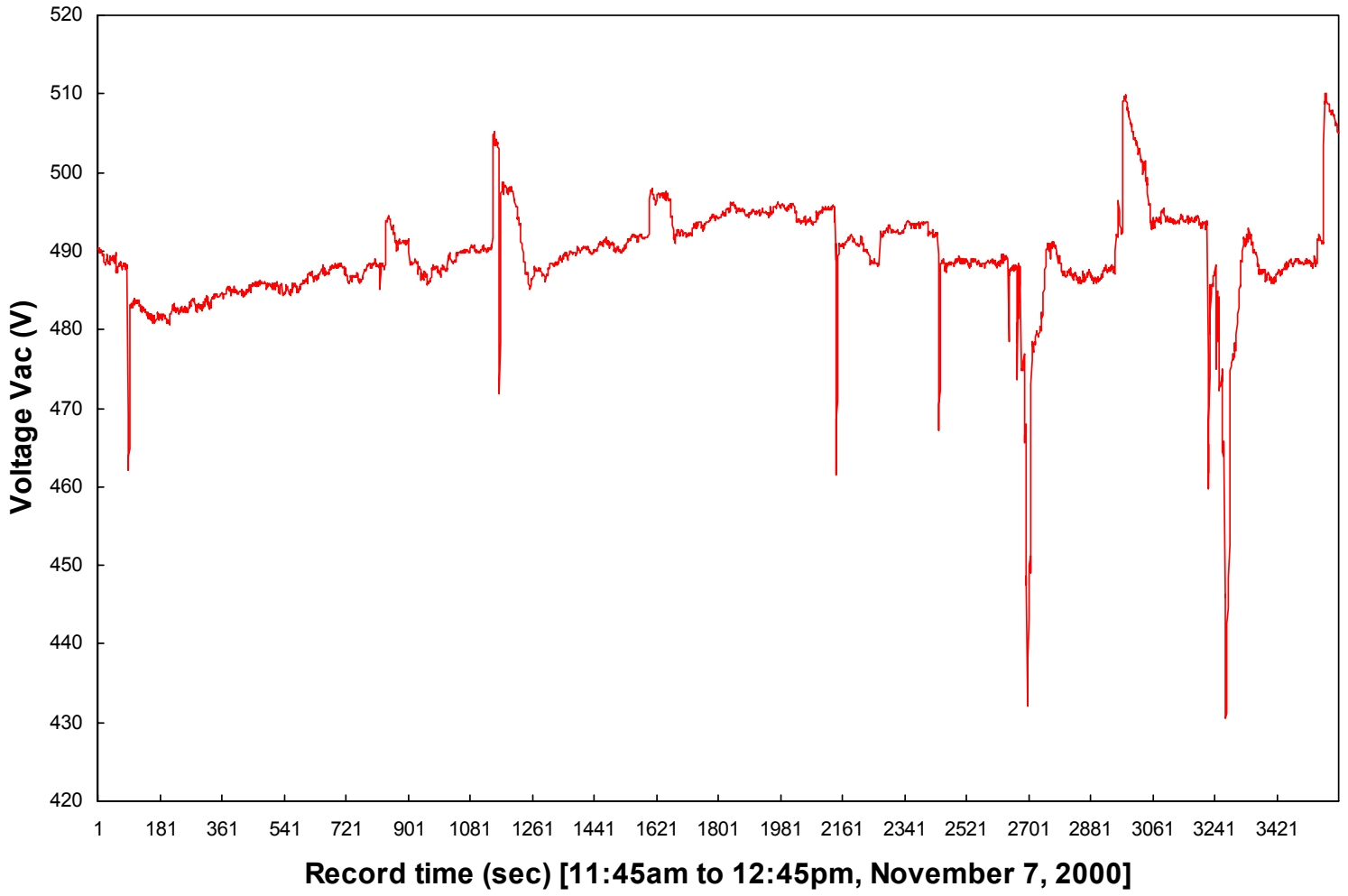
# Portable Battery System

# Detroit Edison Akron Site Description

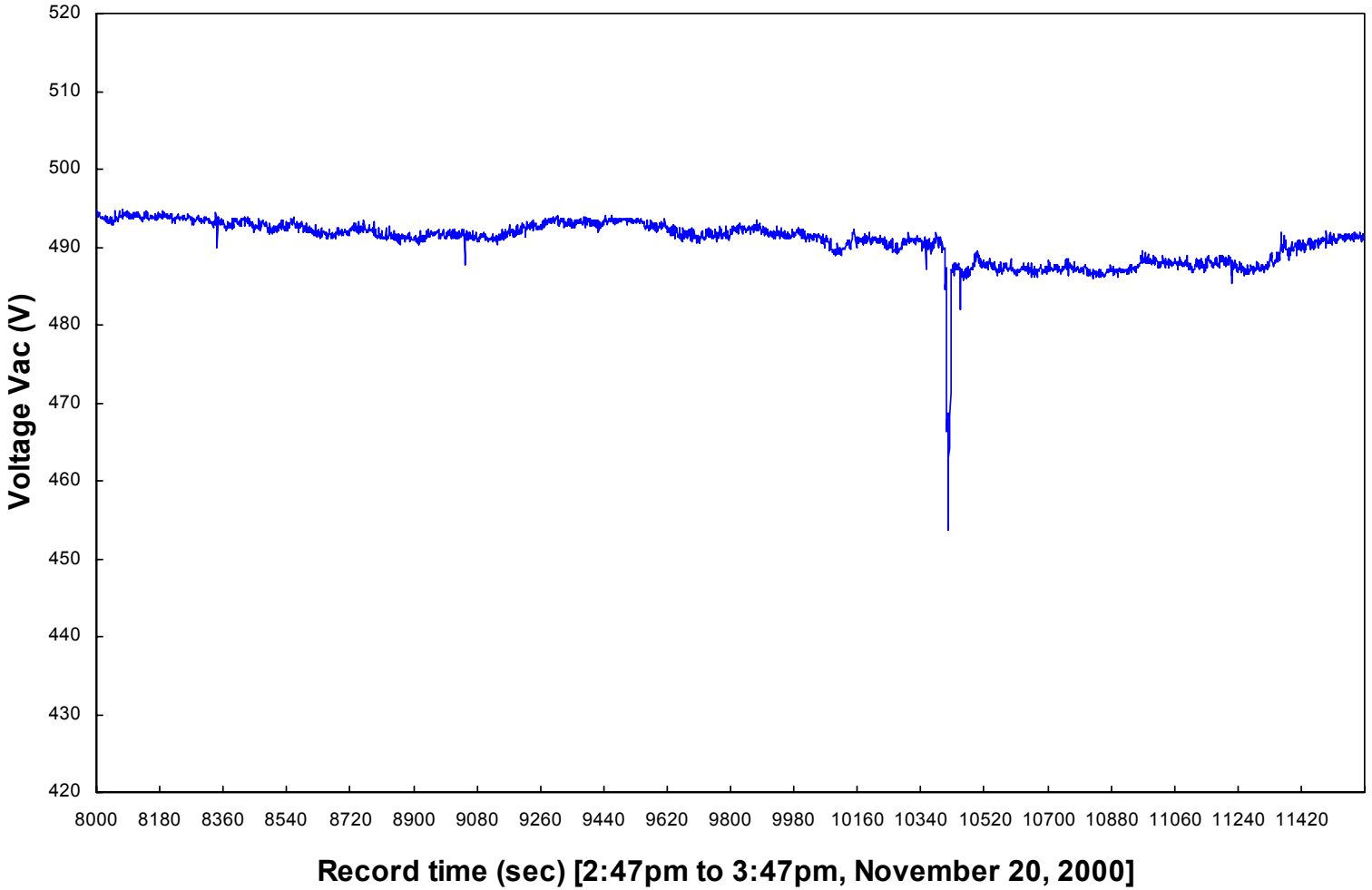
- Grain drying facility in Akron, Michigan
- Primarily power quality application
- Season runs from mid-October to December
- Eight 75 HP motors cause power quality sag issues for other customers on grid
- 4-6 disturbances per day, plus a number of small events due to conveyor

# Akron Grain Drying Facility

# Line Voltage With No Compensation



# Line Voltage With Compensation



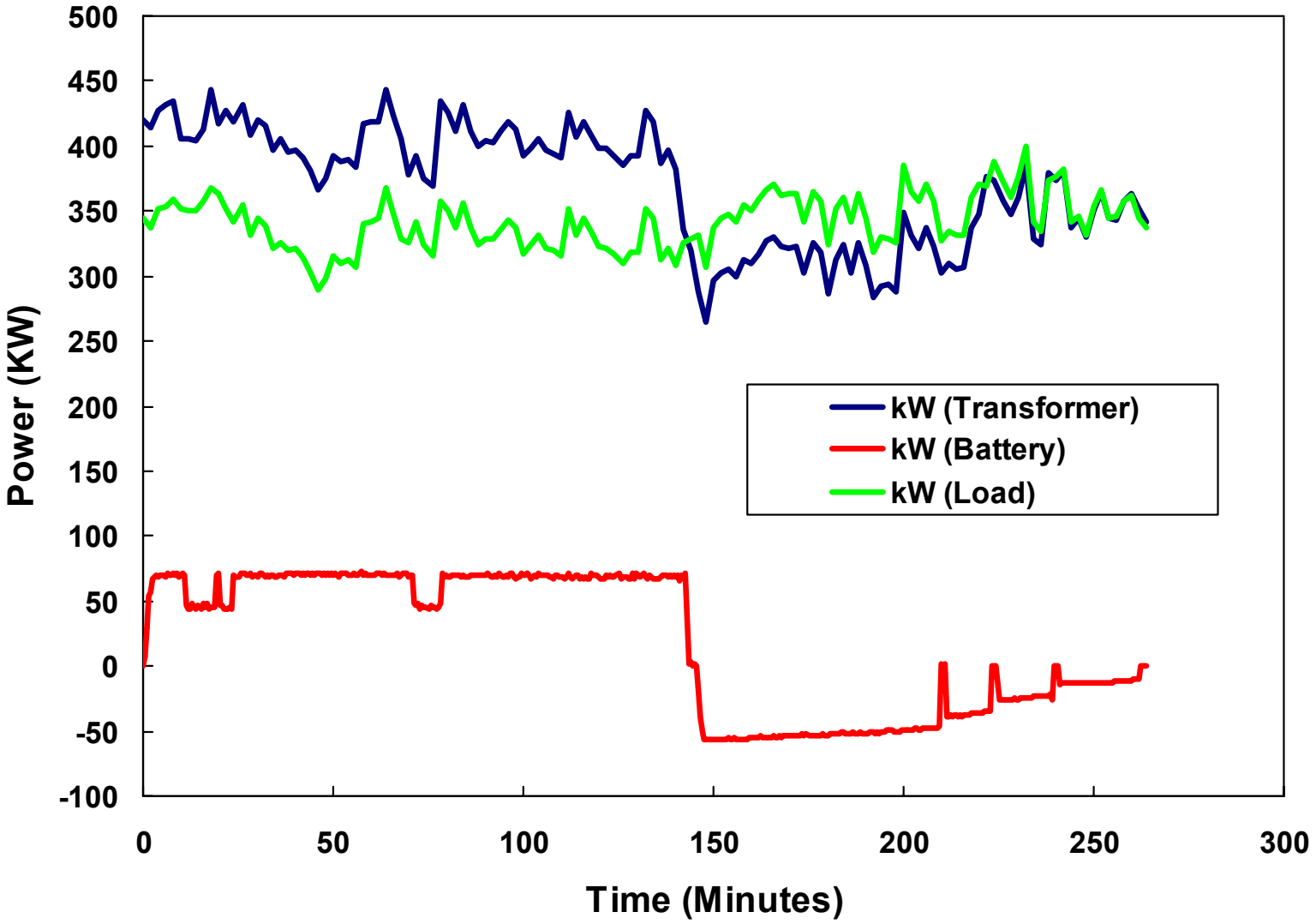
# Detroit Edison
# Lum Site Description

- Peak shaving application
- 800 kVA Transformer near capacity
- Load expected to exceed transformer rating due to summer peaking.

# Lum Peak Shaving Site

# 400 kWh ABESS at Lum Site

# Load on Utility Line



# 400 kWh ABESS Summary

- Successfully demonstrated at two DE sites
- Akron Site Summary (Power Quality)
  - Reduced the line voltage drop associated with start-up of the grain dryer to under 5%
  - Eliminated overvoltage observed during grain dryer shut-down
- Lum Site Summary (Peak Shaving)
  - Demonstrated capability to automatically control ABESS for Peak Shaving application

# Lessons Learned From Program

- Need for data collection prior to sizing ABESS. (Knowledge of voltage sags/surges prior to installation.)
- Transportation could have been performed in one step with a “Low-boy” trailer
- Software and noise issues could not be addressed until ABESS on site
- Automatic load following operation is required

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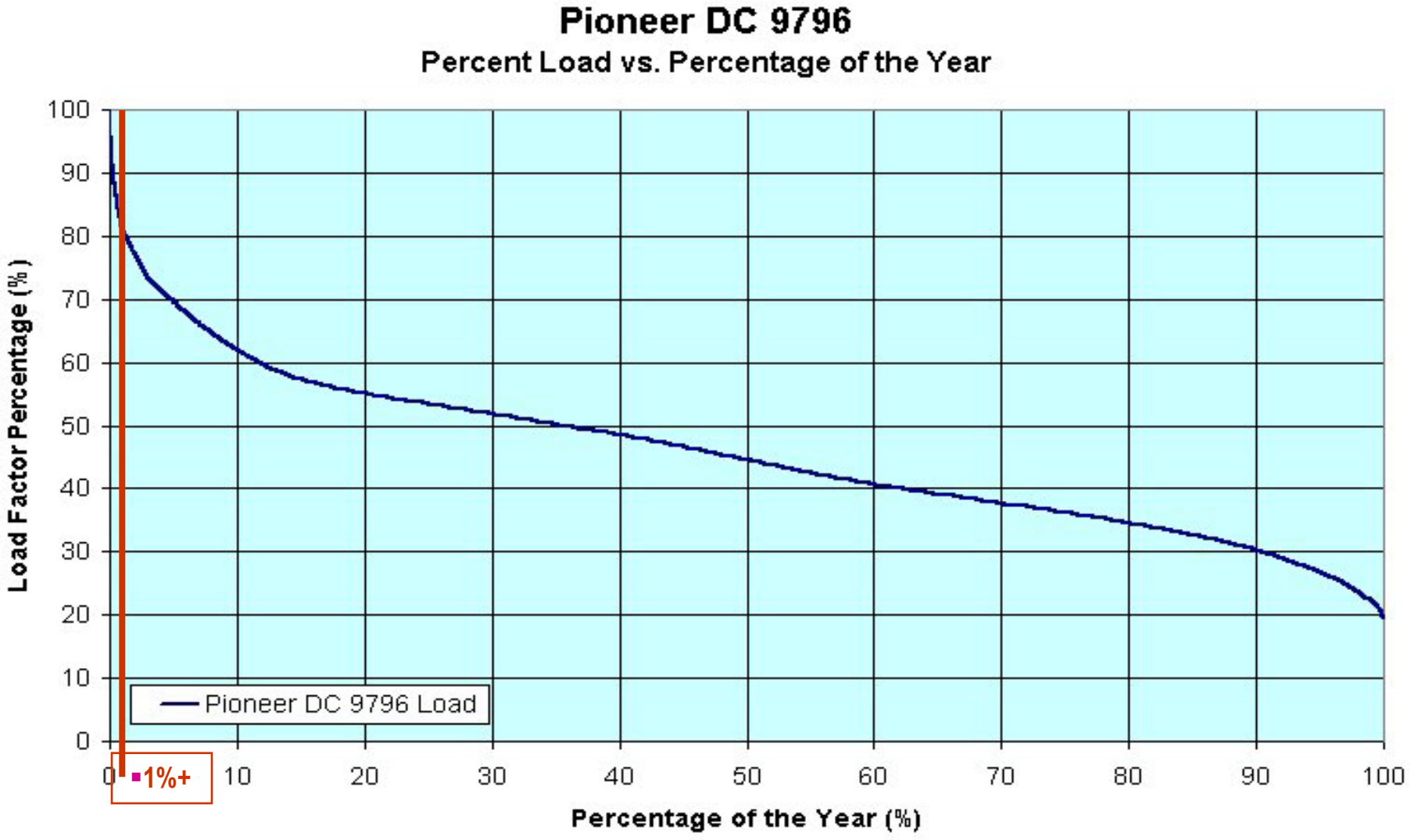
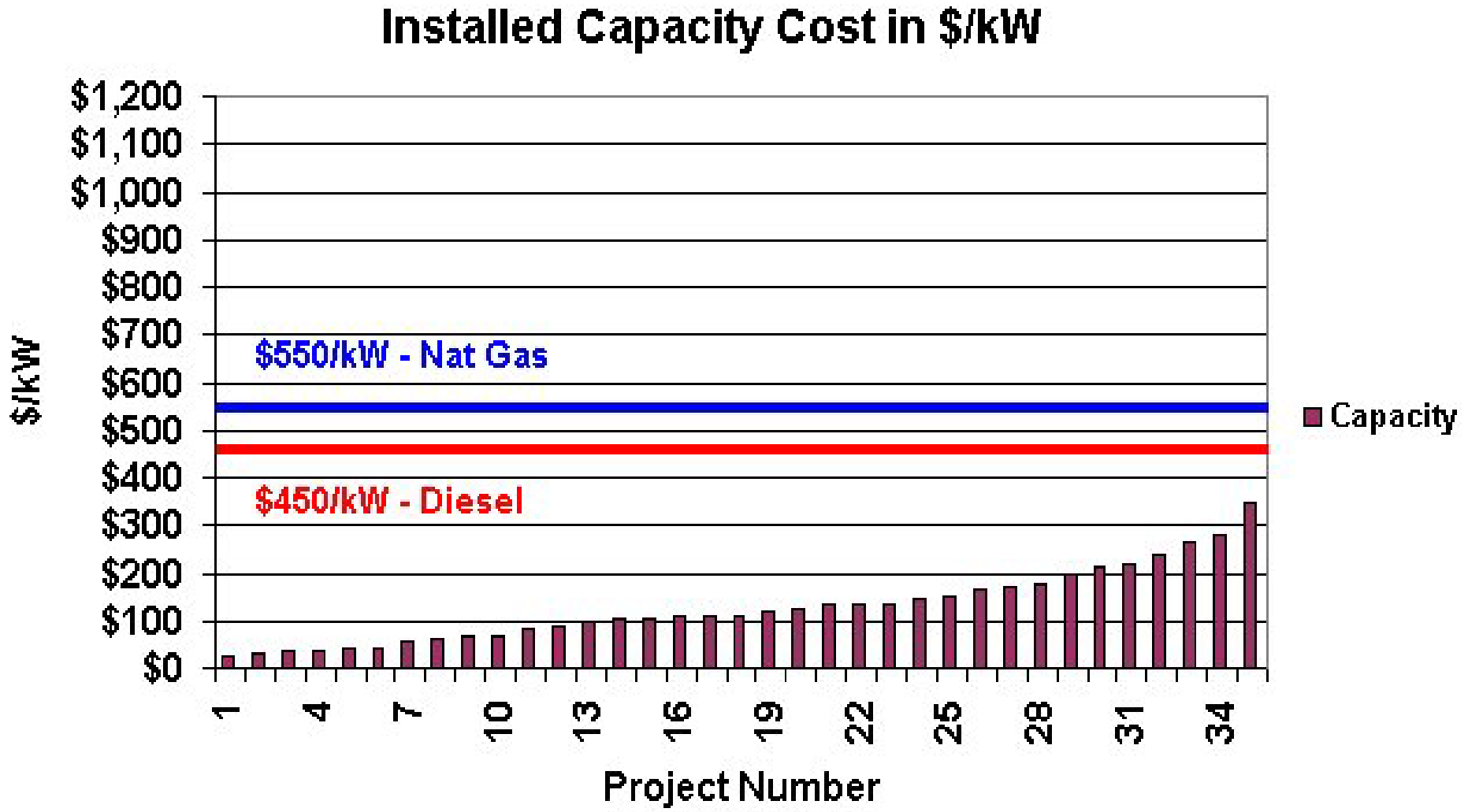
# Asset Utilization Opportunity



# DG Integration – 2003 Review
# Project No vs Project Cost per kW



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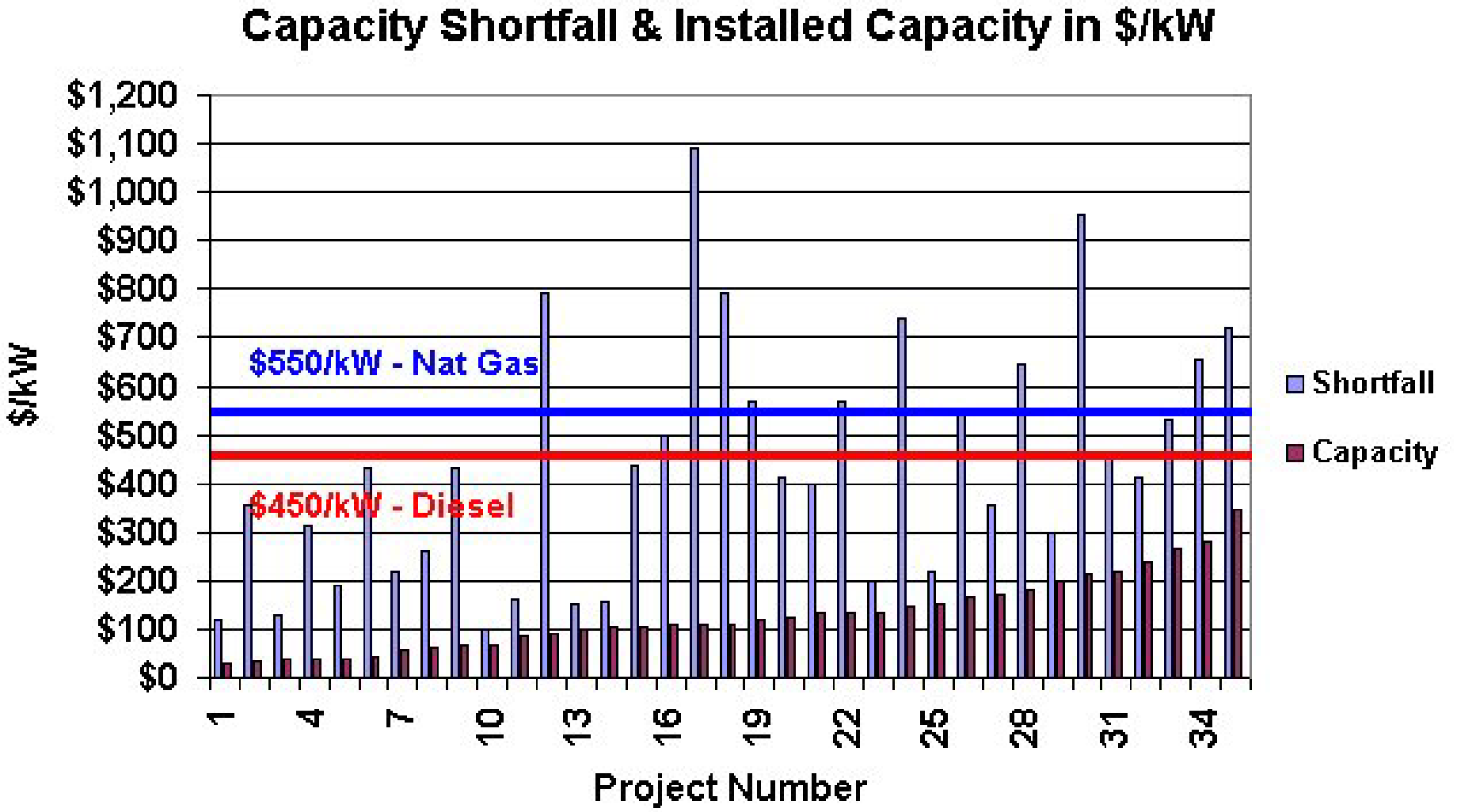


# DG Integration
# Project Evaluation

- What is the cost of capacity addition vs. the cost of meeting the incremental capacity needed by the system?
- Example: Adding 10 MVA of capacity for $1.5 M while the incremental capacity addition needed is 2 MVA for 100 hours
  - 10 MVA capacity addition for $1.5 M = $150/kW
  - 2 MVA shortfall for $1.5 M = $750/kW

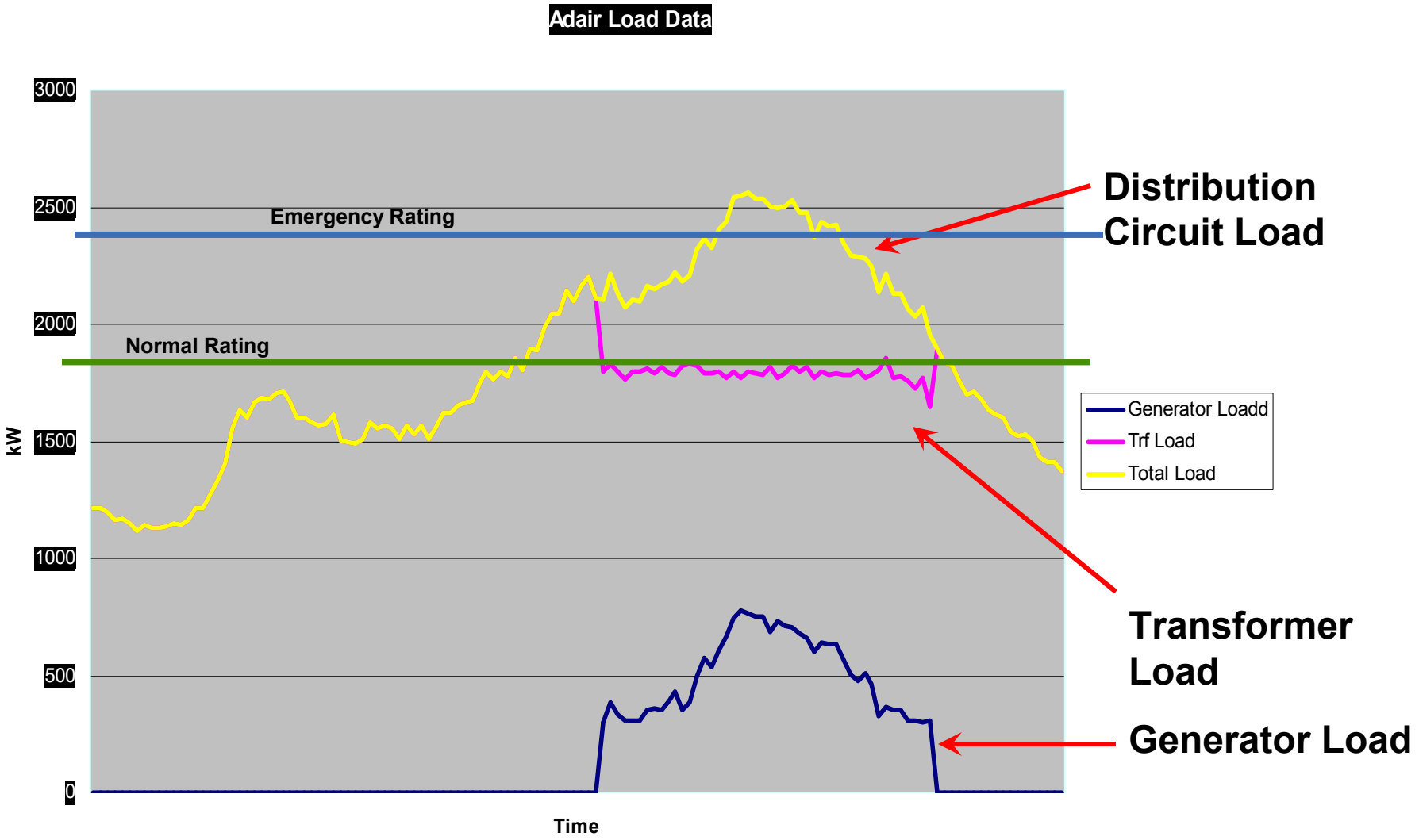
# Distributed Generation Run Hours

| Location | Day-to Day Rating ( Amps ) | 2002 Run Hours | 2002 Days Above | 2003 Run Hours | 2003 Days Above | 2004 Run Hours | 2004 Days Above |
|---|---|---|---|---|---|---|---|
| Adair | | | | | | | |
| DC 322 | 385 | **182** | **27** | **81** | **16** | N/A | N/A |
| Grosse Ile | | | | | | | |
| DC 2841 | 490 | **45** | **7** | **2.5** | **1** | **41** | **7** |
| Shores | | | | | | | |
| DC 1770 | 493 | **22** | **7** | **1.5** | **1** | **9** | **3** |
| Union Lk | | | | | | | |
| DC 1688 | 613 | **265** | **26** | **55** | **13** | **154** | **19** |
| Wayne | | | | | | | |
| DC 9435 | 521 | N/A | N/A | N/A | N/A | **2** | **1** |

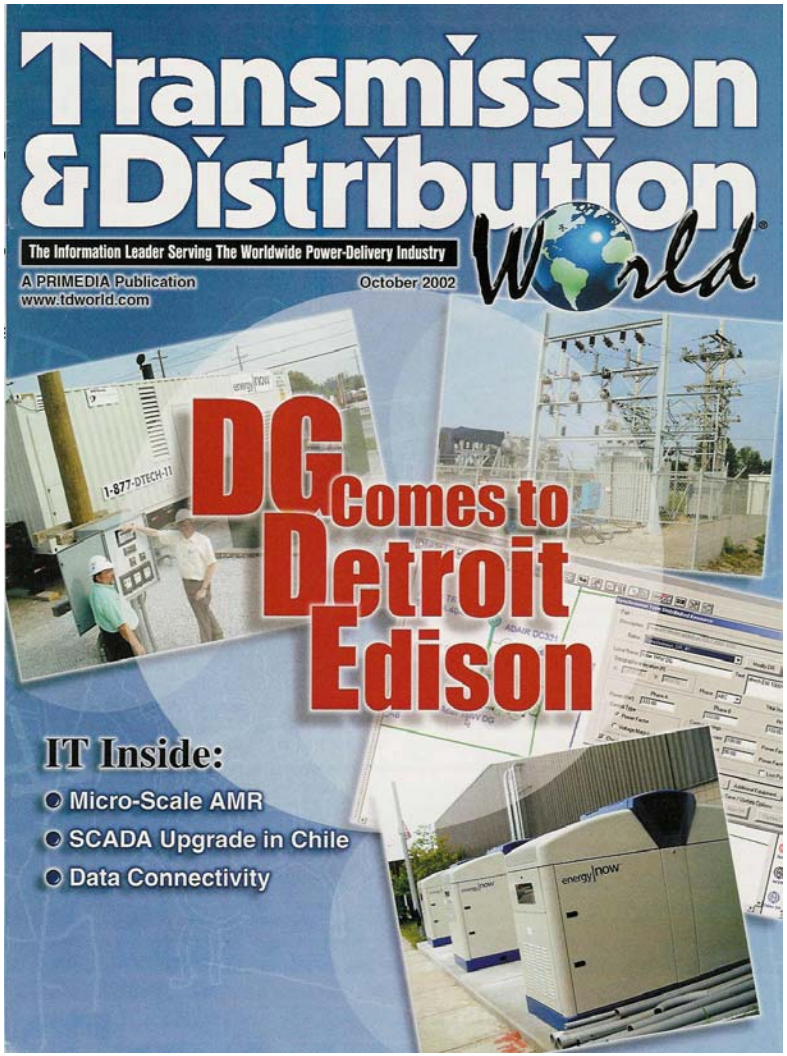
RED indicates amps above circuit emergency rating

2003 and 2004 were cool summers in Michigan. Two days above 90 F in 2003 & 3 days above 90 F in 2004.

# Automatic Load Following

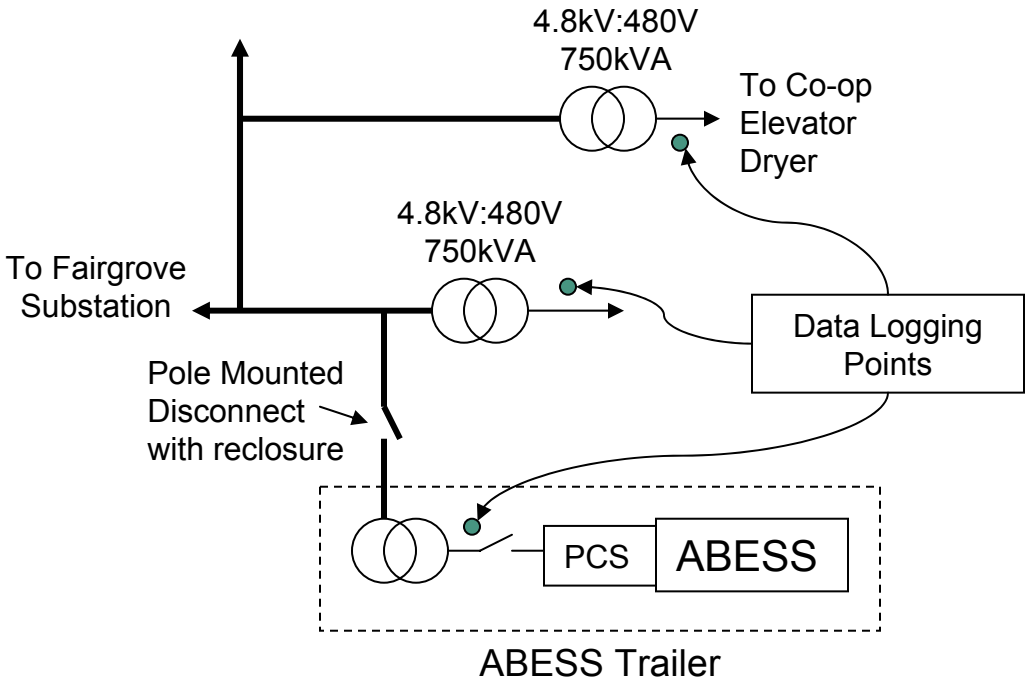


# Conclusion




- Energy storage works
- Automatic operation is required
- DTE Energy believes distributed energy resources will play a major role in the future of the industry
- DTE Energy has significant experience with a variety of distributed generation solutions
- DTE Energy includes distributed generation in planning and operating its grid today

# One-line of ABESS at Akron



# One-line of ABESS at Lum