Energy Storage/Distributed Resource Options at the University of Maryland

Energy Storage Systems Peer Review 2002

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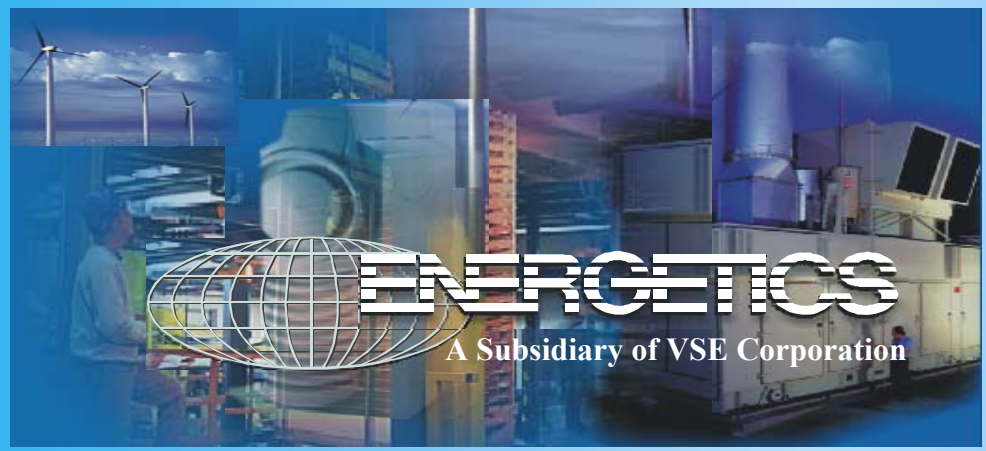

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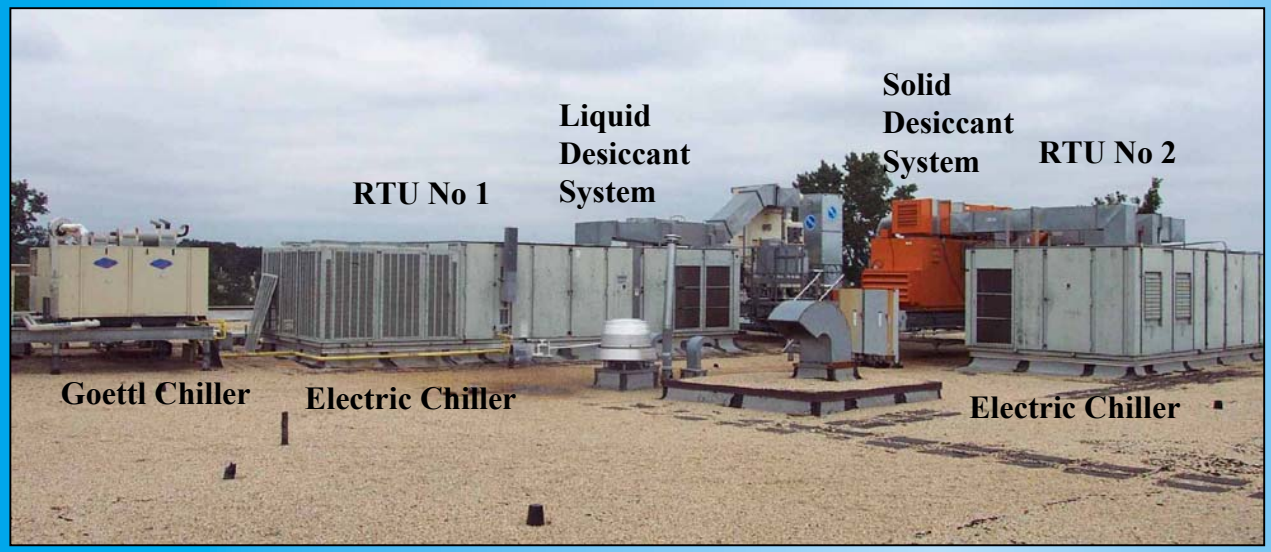
Project Objectives

- Evaluate the net benefit of energy storage at University of Maryland (UM) Chesapeake Building during the winter and summer seasons
- Use enhanced Distributed Energy Technology Simulator
- Examine electricity costs thresholds at which hybrid microturbine/battery storage system becomes beneficial

UM Chesapeake Building

- Medium Size Office Building - 51,000 ft²
- 4 Floors, 2 Zones
- 200 Occupants
- Electric Peak ~ 300 kW

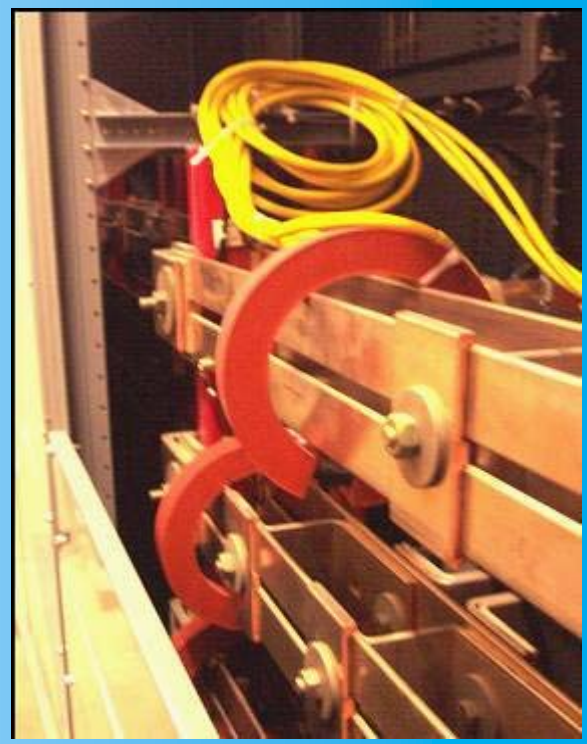
BCHP Systems on the Roof and Ground Floors



BCHP Systems provide cooling and dehumidification to the Chesapeake Building during the summer.

Simulator Installation at UM

Simulator at the University



Current transformers used to read load data

Simulated Technologies

- Flooded Lead-Acid Battery √
- Valve-Regulated Lead-Acid Battery √
- Zinc Bromine Battery √
- Power Quality Battery
- Diesel Generator
- Microturbine √
- Phosphoric Acid Fuel Cell

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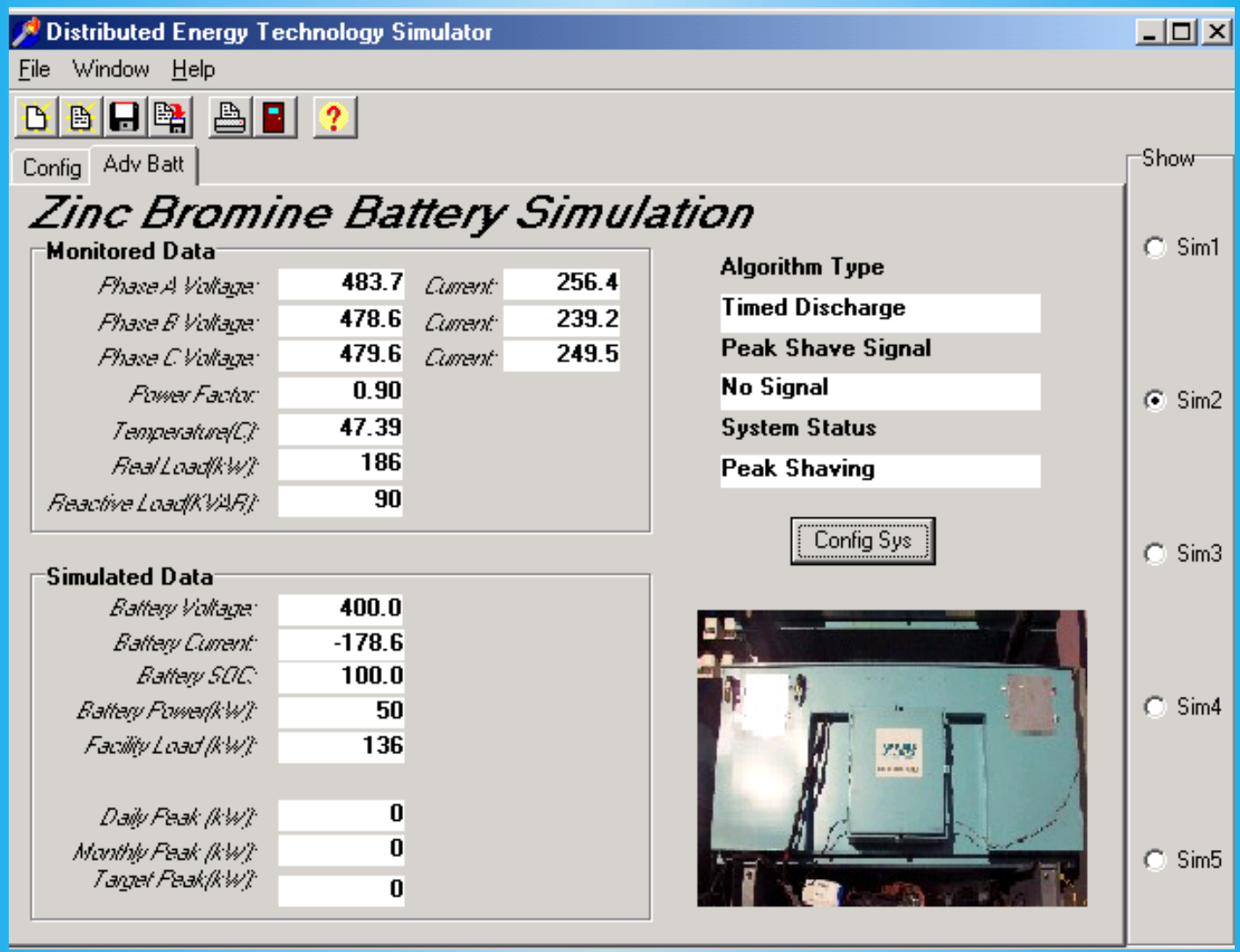
Simulator Software Capabilities

- Real-time meter data collection
- Virtual technology simulation
- Electricity purchases analysis
- Flexibility in technology sizes and operating algorithms
- Graph and tabular display of technical performance data in daily, weekly, and monthly summaries
- Tabular display of economic and environmental performance data in monthly summaries

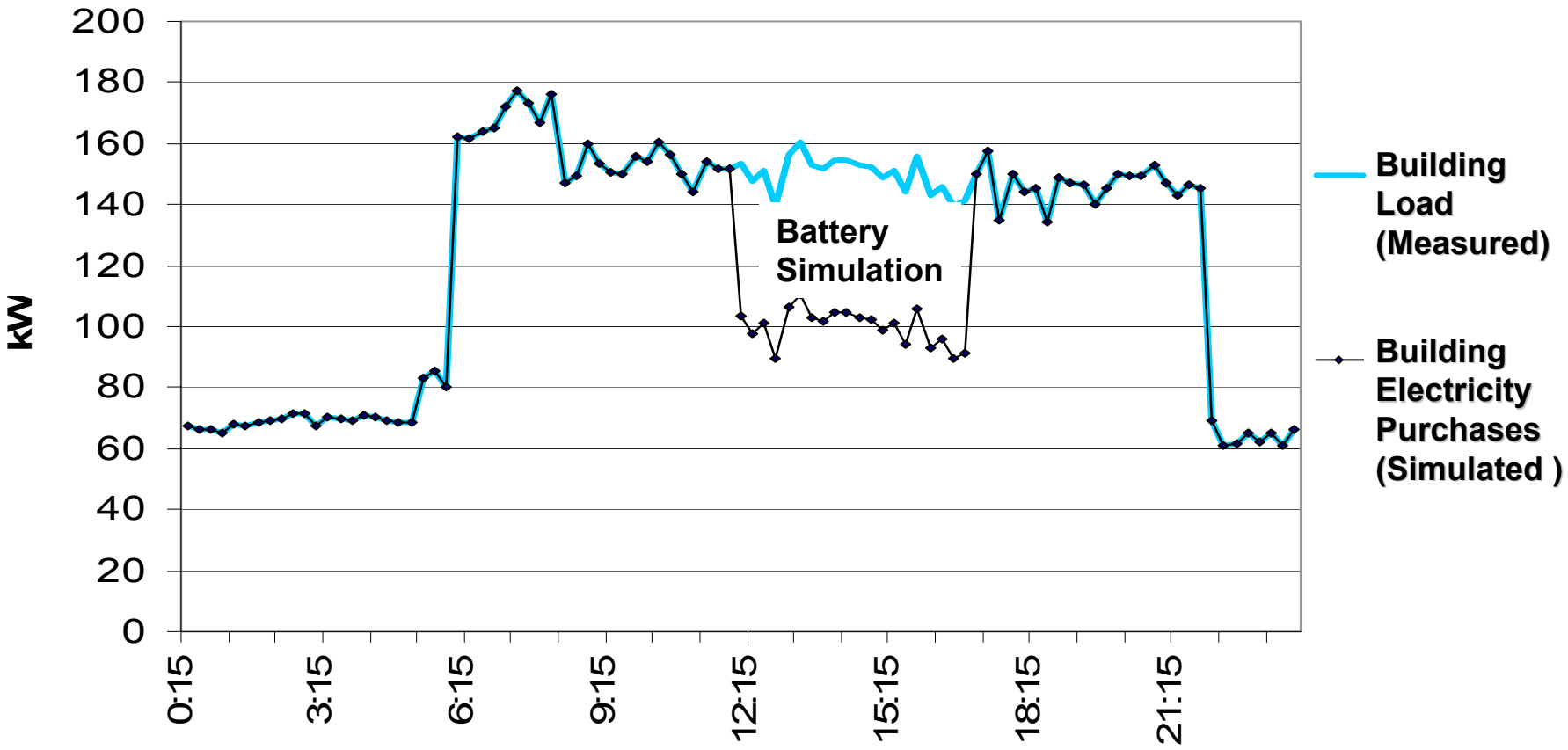
Zinc Bromine Battery Simulation Screen



UM Chesapeake Winter Simulation

- Local Utility: PEPCO
- Peak Rate: $0.049/kWh
- Off-Peak Rate: $0.03/kWh
- Demand Charge: $4/kW
- Peak Period: 12 – 8 PM

- 50-kW/400-kWh battery to peak-shave
- Three technology choices operated from 12 – 5 PM on timed discharge :
  - Flooded lead acid battery
  - VRLA battery
  - Zinc bromine battery



Winter Battery Simulation Results February 4 – March 4, 2002

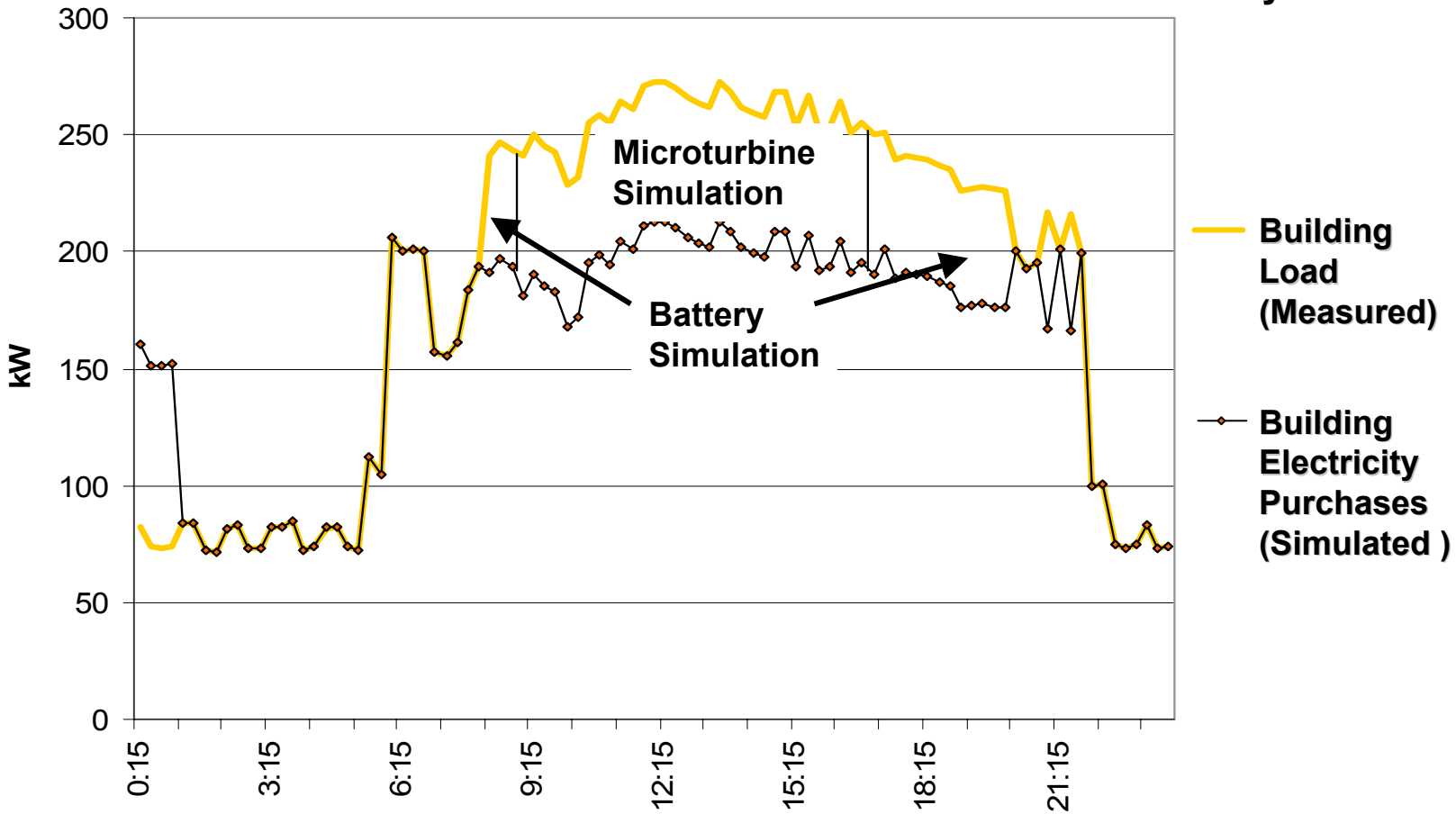
Measure	Flooded	VRLA	ZnBr
Energy Output (kWh)	5,250	5,250	5,250
Peak kWh Purchases	12,533	12,533	12,533
Off-Peak kWh Purchases	75,772	75,462	74,288
Energy Cost Savings ($)	68	77	112
Demand Charge Savings($)	200	200	200
Monthly Savings ($)	268	277	312

This analysis was focused on monthly electric bills savings, not payback or net present value of overhaul, which are calculated from monthly savings and capital and O&M costs.

UM Chesapeake Summer Simulation

- Local Utility: PEPCO
- Peak Rate: $0.057/kWh
- Off-Peak Rate: $0.035/kWh
- Demand Charge: $15/kW
- Peak Period: 12 – 8 PM

- 50-kW/400-kWh battery supplemented 60-kW/480-kWh microturbine, operating from 6 AM – 10 PM :
  - Microturbine + FLA battery
  - Microturbine + VRLA battery
  - Microturbine + ZnBr battery



Summer Battery Simulation Results
July 29 – August 26, 2002

Measure	Flooded	VRLA	ZnBr
Energy Output (kWh)	4,088	4,200	4,200
Peak kWh Purchases	31,671	32,064	32,064
Off-Peak kWh Purchases	71,696	70,854	69,204
Energy Cost Savings ($)	10	29	86
Demand Charge Savings($)	615	670	670
Monthly Savings ($)	625	699	756

This analysis was focused on monthly electric bills savings, not payback or net present value of overhaul, which are calculated from monthly savings and capital and O&M costs.

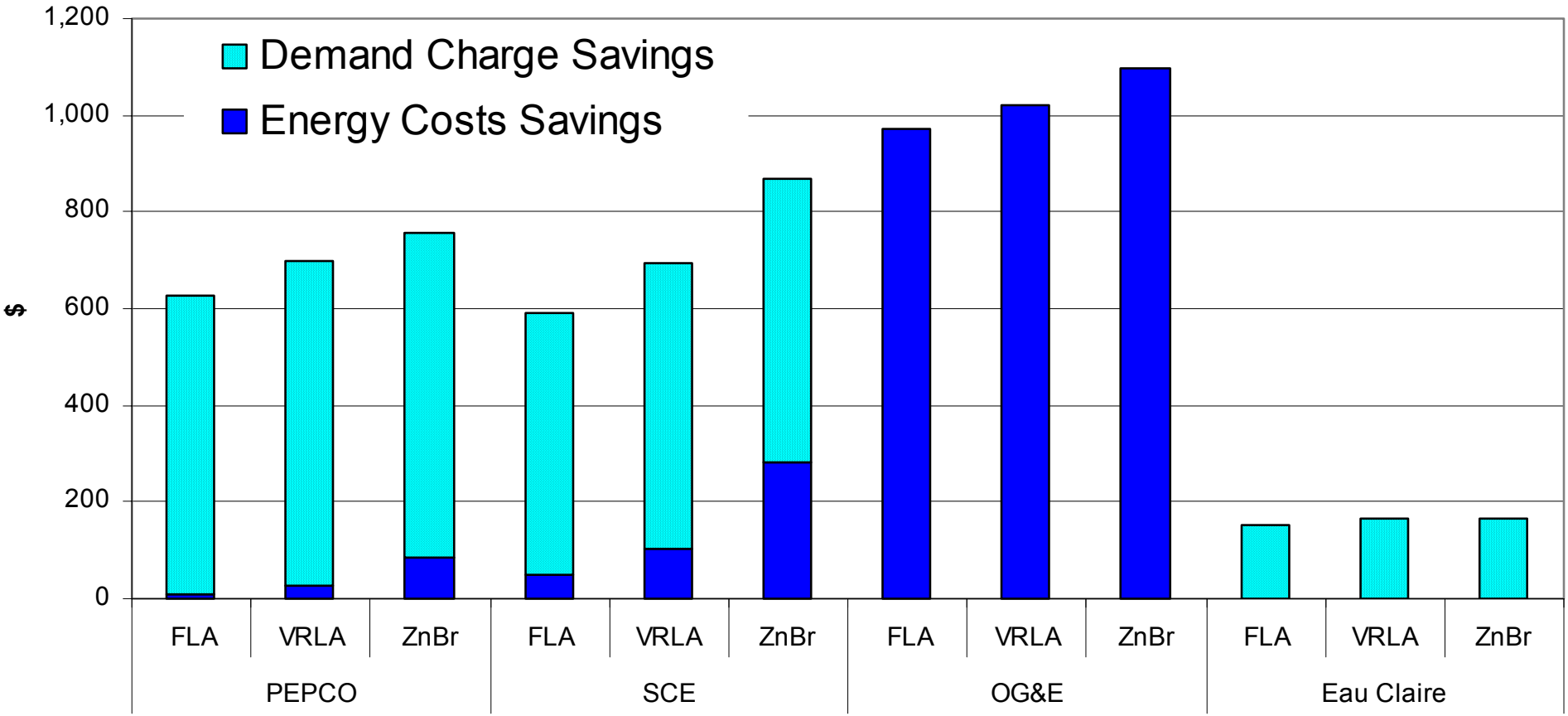
Multiple Tariffs Analysis

Rate	PEPCO*	SCE*	OG&E*	Eau Claire*
On-peak electric (¢/kWh)	5.76	17.88	30.97	4.2
Mid-peak electric (¢/kWh)	5.09	12.2	N/A	4.2
Off-peak electric (¢/kWh)	3.5	10.59	4.57	4.2
Peak demand charges ($/kW)	15.00	13.15	0.00	12.35

- The summer simulation data was used with the three utilities' electricity charges.
- Three technology choices operated similarly from 6 AM – 10 PM on timed discharge and auto-bulk peaking algorithms :
  - Microturbine + Flooded lead acid battery
  - Microturbine + VRLA battery
  - Microturbine + Zinc bromine battery

*PEPCO: Potomac Electric Power Company, SCE: Southern California Edison, OG&E: Oklahoma Gas & Electric, Eau Claire: Eau Claire Electric Coop in Wisconsin

Hybrid Technology Savings under Multiple Tariffs



FLA = Flooded Lead-acid Battery, VRLA = Valve-regulated Lead-acid Battery, ZnBr = Zinc Bromine Battery

Conclusion

- Monthly savings vary significantly from one utility to another. However, the savings grow as a function of the gap between peak and off-peak electricity rates.
- Zinc bromine batteries are somewhat favored when there is a delta between peak and off-peak electricity charges.
- When focusing on monthly electric bills savings, batteries can be beneficial at UM. Additional analysis taking into account the technologies' capital cost and operation and maintenance costs is recommended before taking a final decision.

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