

# RIDGE

ENERGY STORAGE  
& GRID SERVICES L.P.



**Solar Turbines**  
A Caterpillar Company

**DRESSER-RAND**

**Mini-CAES**

*Early Discussion of Ongoing Economic Feasibility Assessment*

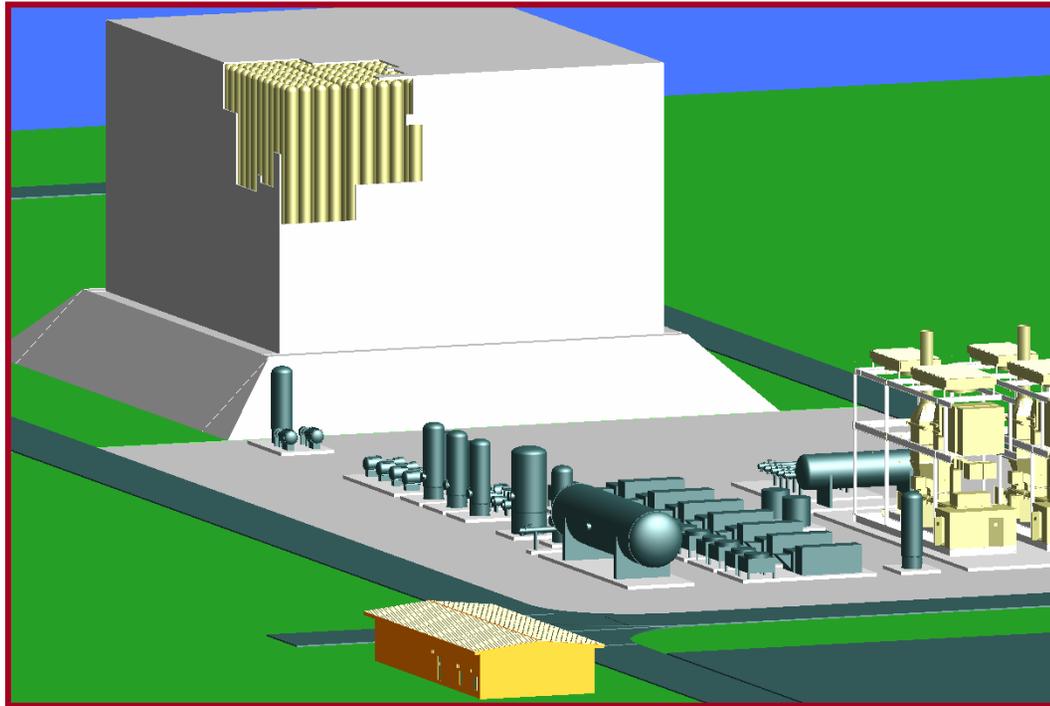
# *ACKNOWLEDGMENTS*

- ◆ This project is part of the Joint Initiative between the New York State Energy Research and Development Authority (NYSERDA) and the Energy Storage Systems Program of the U.S. Department of Energy (DOE/ESS) through Sandia National Laboratories (SNL).

# *Flexibly Site Energy Storage*

- ◇ ~12MW generation capacity
- ◇ ~ 5, 10, 15 MW compression
- ◇ HR ~ 4100 Btu/kWh
- ◇ Applications
  - Urban sites (4-6 story building)
  - Wind generation storage

# VOLANDS™ Gas Storage



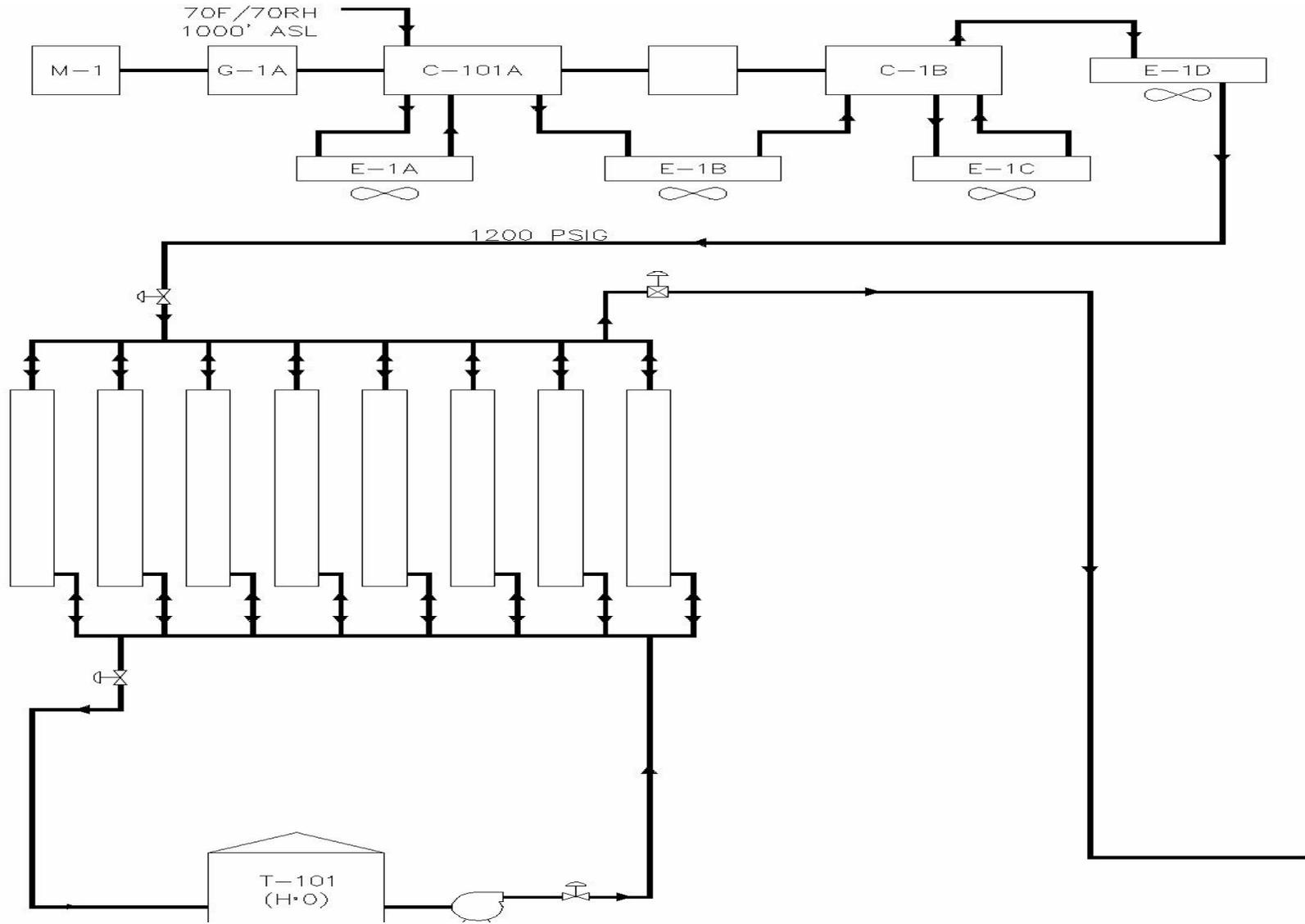
- ◆ No geological constraints
- ◆ Flexible storage volume
- ◆ Delivers constant pressure/temperature air
- ◆ ~250' x 200' Plot

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# *Typical CAES Value Drivers*

- ◆ Buy Low - Sell High
- ◆ Wind Power Shaping
  - Storage matches availability
  - Deliver as Needed or “Peak”
- ◆ Ancillary Services
  - VAR, Black Start, Spinning Reserve
- ◆ System Values
  - Shadow Ramping
  - Absorbing Power (wind and base load plants)
  - Stability
- ◆ Defer Construction of T & D Resources

# Mini-CAES-Compr/Storage





# Capital Costs-Base 5:9 plant\*

◆ Capital Equipment	--\$ 22MM
◆ Construction	--\$ 13MM
◆ Engineering	--\$ 2MM
◆ Owner Costs	--\$ 7-9MM**

\*Costs are preliminary.

\*\*Site, permitting, grid interconnects, construction management.

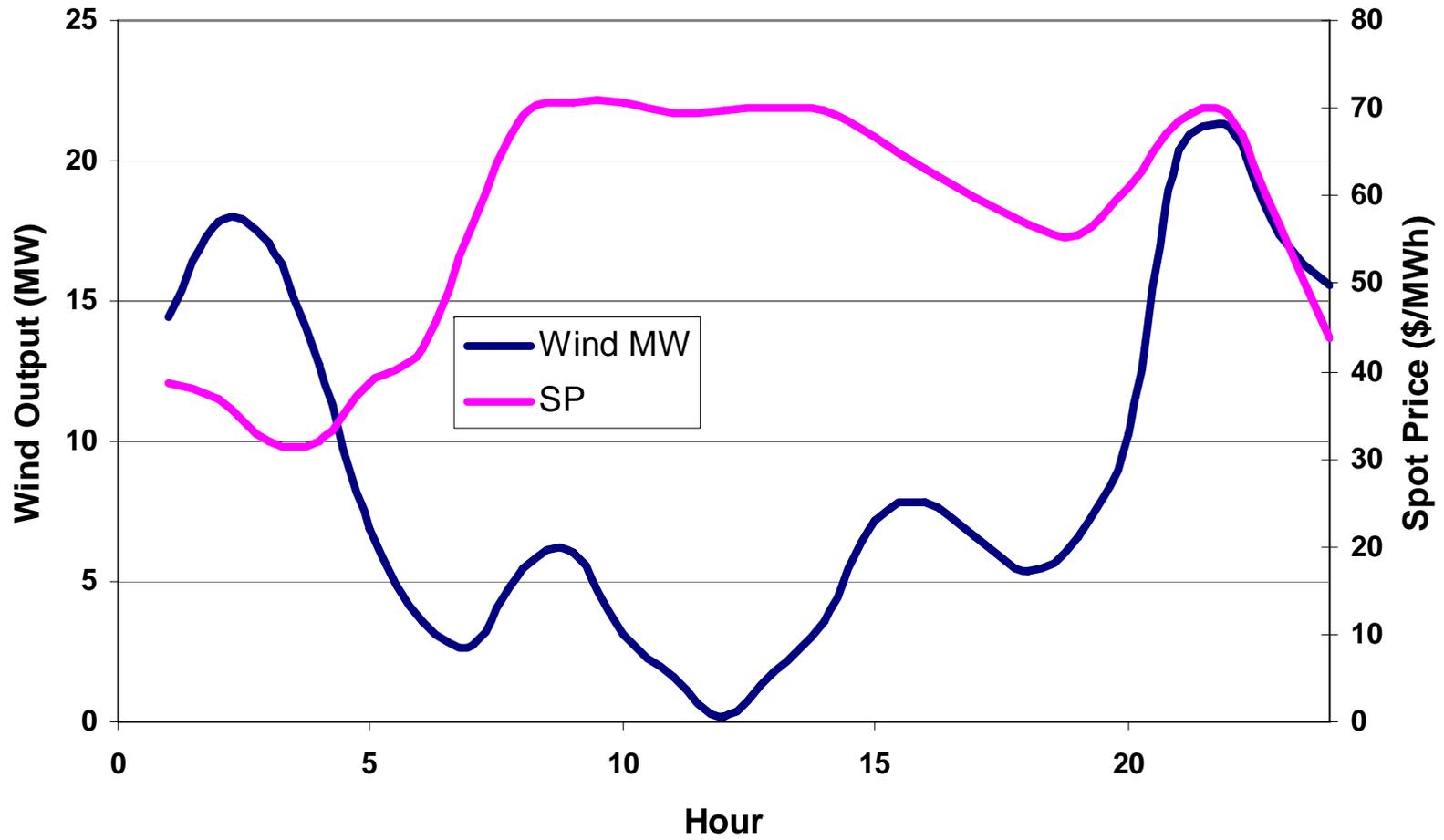
# Operation

- ◆ Small/no permanent staff
- ◆ Remote likely
- ◆ Minimal routine maintenance
- ◆ Major overhauls
  - 20-25,000 hours CT
  - 50-100k hours Compression

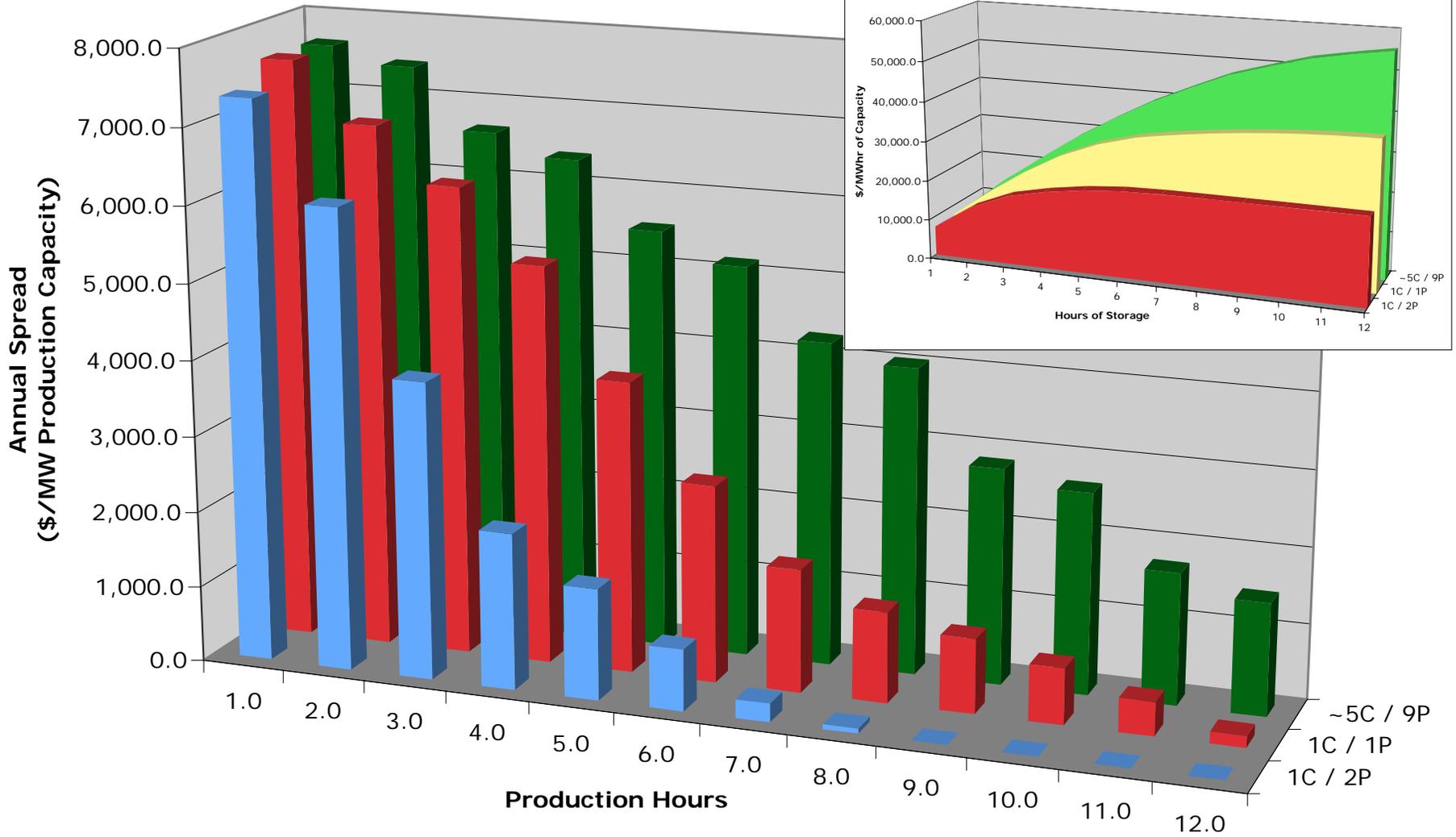
## *NY Wind Sites Evaluated*

<b>NY Zone</b>	<b>ENERGY (GWH)</b>	<b>CAPACITY (MW)</b>	<b>CAPACITY FACTOR</b>
<b>MOHAWK</b>	<b>890</b>	<b>300</b>	<b>34%</b>
<b>WEST</b>	<b>298</b>	<b>110</b>	<b>32%</b>
<b>HUDSON</b>	<b>126</b>	<b>50</b>	<b>29%</b>
<b>LONG ISLAND</b>	<b>1,125</b>	<b>300</b>	<b>44%</b>

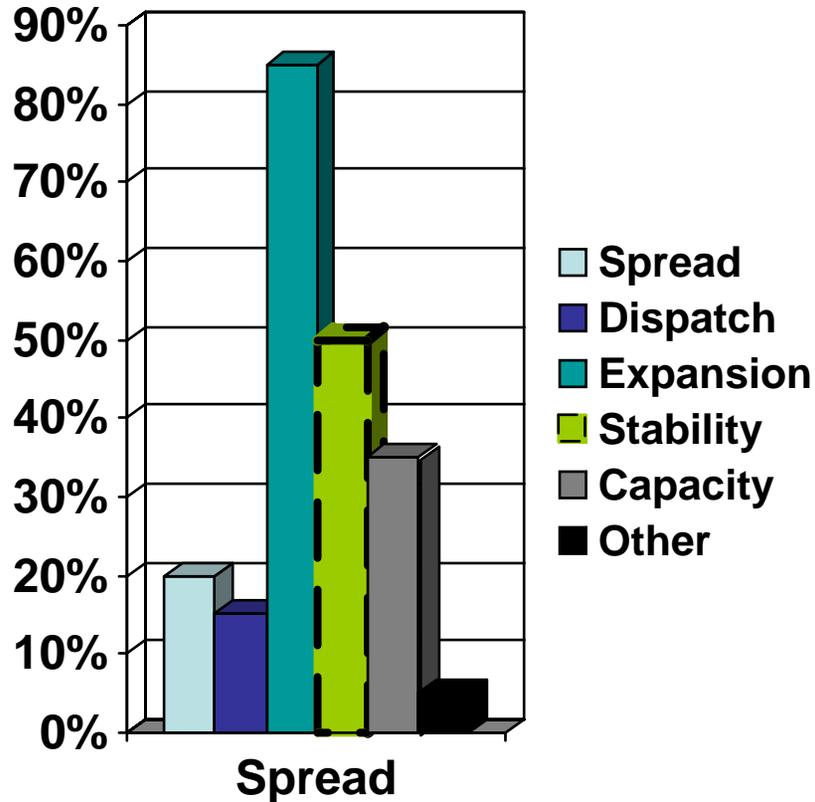
### Sample Daily Pattern



### Spread Value by Storage Duration - Long Island Site



# Value Balance



- ◇ Spread Value
- ◇ Dispatch
  - Tariff Wind / CAES Link
- ◇ Expansion & Reliability
  - Site Specific
  - Defer Expansions
  - Reduce Outages
- ◇ Capacity
- ◇ Other Values
  - Reduced T & D Losses
  - Reactive Power & Voltage Support
  - Spinning Reserves, Black Start

# Mini-CAES Conclusions

- ◆ Capacity cost is multiples of large CAES
- ◆ Mini-CAES brings different benefits than full scale
- ◆ Urban sites bring highly integrated value - hard to monetize
  
- ◆ Primary issues:
  - CAES versus aero-derivatives & other DG
  - New small storage technologies are coming
  - Potential savings from packaging the components
  - Mini-CAES benefits utilities with T & D
- ◆ The comparisons are beyond the scope of this study
  
- ◆ Probable result: Mini-CAES will only be applied with utility sponsorship