



# *Battery Energy Storage for Residential Photovoltaic Systems*

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# *So what is going on in California?*

- 299 PV systems installed and approved under CEC Emerging Renewables Buydown program in the first two years of the program.
- Over 75% of these systems include some amount of battery storage. (Even higher percentage among residential projects)



# *Observations about the California Market*

- Y2K had a significant impact on awareness.
- Although sales slumped somewhat at the beginning of this year, system sales have rebounded.
- Pre-Y2K buying habits (including batteries) continue to be reflected.



# *Observations about the California Market (cont.)*

- The CEC Buydown program does not apply to the battery portion of the systems. (even though several attempts were made to include batteries).
- Battery options are generally preferred and actually help sell the PV system by providing firm backup power capabilities.
- Batteries are here to stay in this market.



# *Types of batteries used in grid-connected PV systems*

- Some contractors are still using flooded lead-acid batteries. (Typical of remote homes)
  - Advantage—Low cost, high performance
  - Disadvantage—High maintenance (major issue)
- Most appropriate battery for this market is the Valve-Regulated Lead-Acid (VRLA) battery.
  - Advantage—Low maintenance, good performance
  - Disadvantage—Higher cost, intolerant of high temperatures or improper regulation voltages.



# VRLA Batteries

- Enclosures need very little ventilation. Best if placed in garage or in an outdoor enclosure.
- Enclosure should be in shade and/or conditioned to prevent high temperatures.
- AGM and Gelled Types available. AGM may be slightly more suitable for this application.
- Batteries are generally kept at float voltage which **MUST** be temperature compensated to protect the battery from loss of electrolyte at high temperatures.



# *Building Inspectors*

- Inspectors unfamiliar with reviewing battery installations.
- Inspector's requirements vary from plywood boxes to explosion-proof enclosures with four-hour fire ratings.
- Very few batteries or battery enclosures have listings or recognitions by testing labs.
- PV is blazing the way for a whole series of backup power options for residential and commercial customers.



# *The Vacaville Host Site of PVUSA*



- Where's the sun?



*Where's the SHADE!*



*There it is*



*From the top*



# *The California Patio Cover*

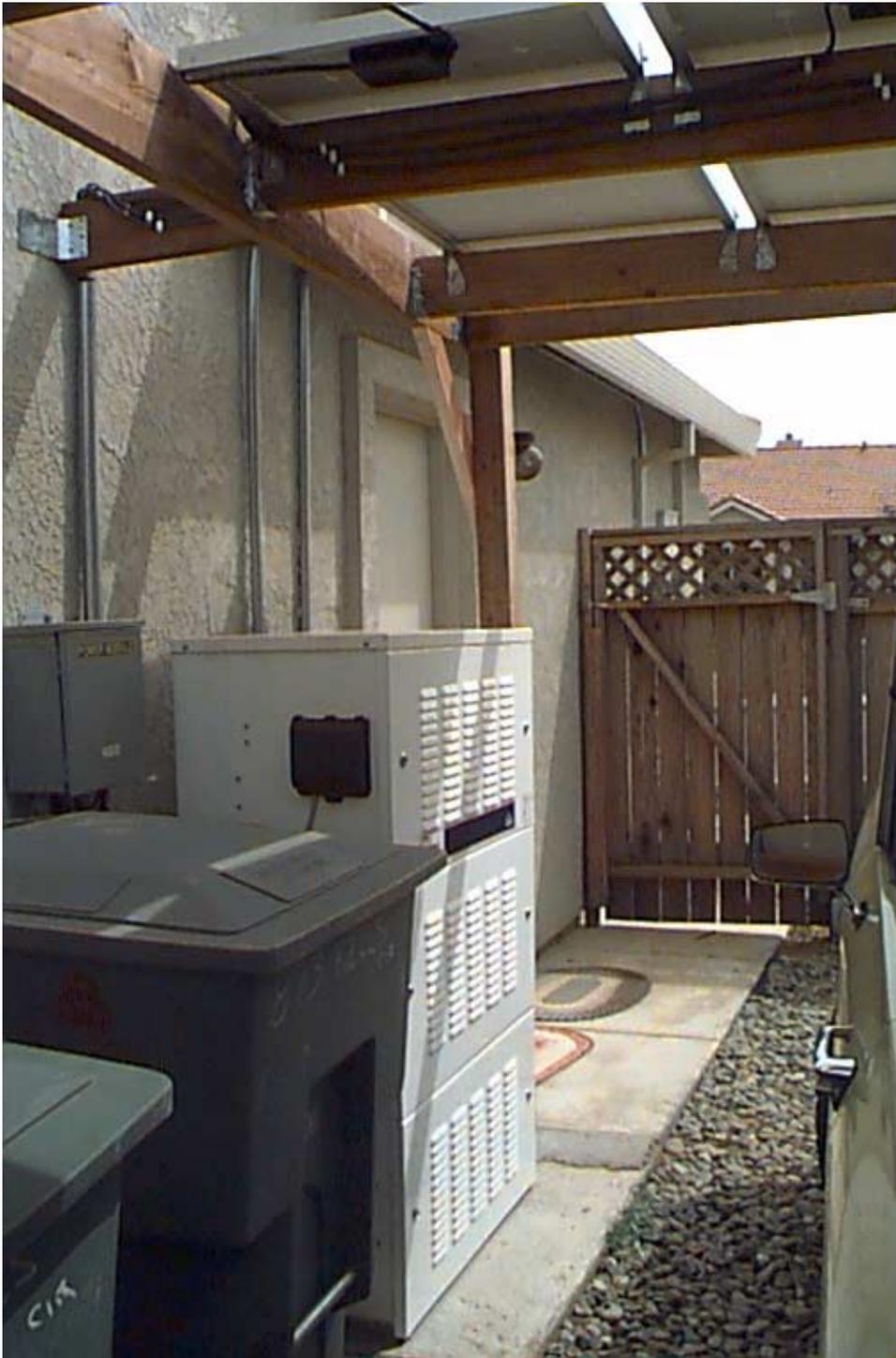






# *The Carport*





# *Trace 5548 Power Module*

- 5.5kW ac rating
- 44-60V dc input
- 120Vac output
- Batteries and controls all in the same cabinet
- Up to 12 kWh in storage cabinet. (this shows 8 kWh option)
- Unit backs up all 120V house loads



# *More Battery is ALWAYS better*

- Additional battery supplied by C&D Battery with the assistance of Paul Beeson of Celerity Power
- Climate-controlled enclosure provided by Champion (also with Celerity's assistance)





## *The Battery Shrine*

- 48 Volt, 450 amp-hr (21 kWh battery) of AGM

construction—potential 20 year life if treated properly in float application.

- Rack includes seismic bracing and airflow around all cells.





Every home  
needs one!!



*Letting the sun do the work*



# *The Manual Disconnect*

*(and, more  
importantly,  
the backwards  
turning meter)*

System produces all the  
electricity needed by  
the home on an annual  
basis

