

How to Save Money, Protect Your Facility and Reduce Your Carbon Footprint with Advanced Energy Storage

**Utility Savings & Refund, LLC for
Prudent Energy, Inc.**

Charles R. Toca

(949) 474-0511 x203

ctoca@utility-savings.com

www.Utility-Savings.com



Is This Your Company?

Curtailment, Interruptions, Black-Outs a concern.

Diesel Back-up Generators – O&M, Emissions – will it work?

On Site Power not an option?

7 – 9 Significant Power Quality events per year.

Voltage Drops Interrupt Production – Scrap, Downtime.

Power Quality from Utility will degrade in the future.

High Utility Bills – Peak Demand Charges

Green - Corporate priority to reduce carbon footprint, environmental and social benefits.



Benefits of Advanced Energy Storage

1. Uninterruptible Power Supply and Power Conditioning (UPS) for the entire facility.
2. Improved Power Quality – no trips and reduced energy use.
3. Emergency Back-up Power – No Emissions.
4. Peak Demand Reduction – Reduced Electric Bills
5. Environmental and Social Benefits Related to no Diesel BUG, Renewable Energy Integration, Power Grid Reliability and Reduced Greenhouse Gas Emissions.
6. Costs Subsidized by Grid Support Services to CAISO and Utility Demand Response Programs.
7. Alternatives to Lead Acid Batteries.

Advanced energy storage systems are now commercially available

Storage Technologies	Main Advantages (relative)	Disadvantages (Relative)	Power Application	Energy Application
Pumped Storage	High Capacity, Low Cost	Special Site Requirement		●
CAES	High Capacity, Low Cost	Special Site Requirement, Need Gas Fuel		●
Flow Batteries: PSB VRB ZnBr	High Capacity, Independent Power and Energy Ratings	Low Energy Density	◐	●
Metal-Air	Very High Energy Density	Electric Charging is Difficult		●
NaS	High Power & Energy Densities, High Efficiency	Production Cost, Safety Concerns (addressed in design)	●	●
Li-ion	High Power & Energy Densities, High Efficiency	High Production Cost, Requires Special Charging Circuit	●	○
Ni-Cd	High Power & Energy Densities, Efficiency		●	◐
Other Advanced Batteries	High Power & Energy Densities, High Efficiency	High Production Cost	●	○
Lead-Acid	Low Capital Cost	Limited Cycle Life when Deeply Discharged	●	○
Flywheels	High Power	Low Energy density	●	○
SMES, DSMES	High Power	Low Energy Density, High Production Cost	●	
E.C. Capacitors	Long Cycle Life, High Efficiency	Low Energy Density	●	◐



www.electricitystorage.org



AES Distinctives

Capacity + Storage

- » 100 kW + 1 hour storage = 100 kWhr
- » 5 MW + 4 hour storage = 20 MWhr

Longer Life - more cycles

Clean Tech - emissions, disposal

Higher first cost, lower life cycle cost

Incentives are being developed

DISCLOSURE: Utility Savings & Refund, LLC is a Sales Affiliate for Prudent Energy International and the Vanadium Redox Flow Battery (VRB).

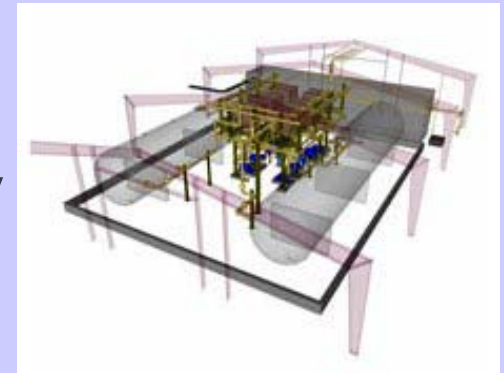
More information on AES at www.electricitystorage.org



Flow Batteries

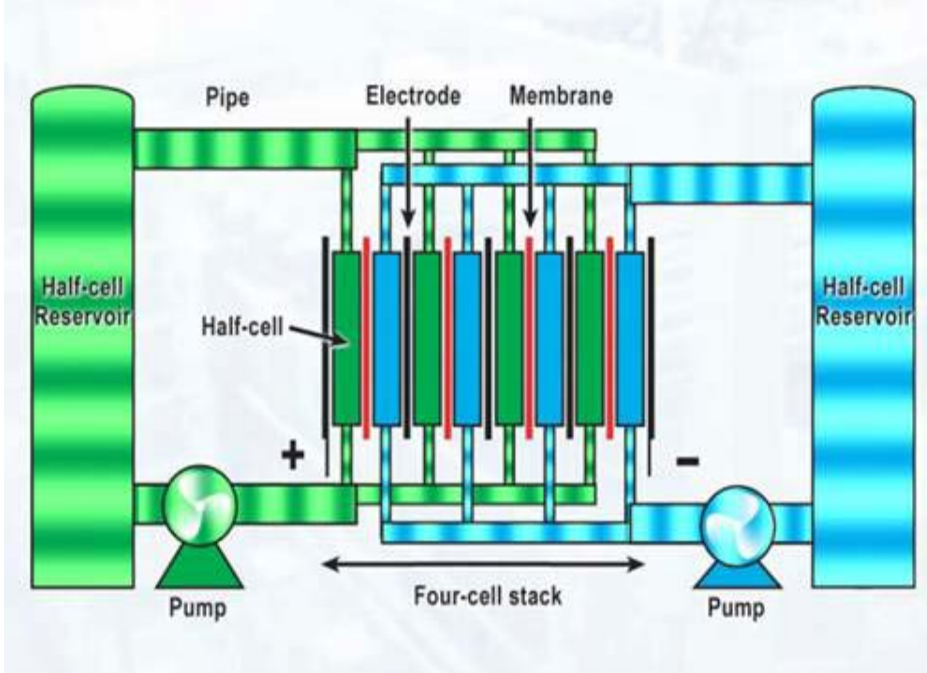
VRB Energy Storage System

- » Electrolyte stored in tanks
- » Vanadium in dilute sulfuric acid
- » 30% strength of lead acid battery
- » Unlimited charge cycles
- » Long life, 20 plus years

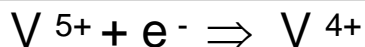


VRB Flow Battery Technology

A liquid electrolyte that is separate from the electrode.



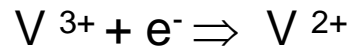
Positive Electrolyte



Charge

Discharge

Negative Electrolyte



- An electrochemical energy storage system operating at **ambient** temperatures
- Reversible fuel cell – reduction and oxidation of single unique element: Vanadium (no catalysts)
- **No cross** contamination
- Electrolyte **never wears out** – high residual value
- Very low maintenance
- Deep cycles >**unlimited or ten years**
- Sized 5kW to 10MW – indefinite energy storage
- Energy can be recovered instantaneously
- Battery can recharge as almost as fast as it discharges (1.5 to:1)
- Power and Energy separately scalable

Proven Technology – Prudent Energy International

250 kW x 8 hour VRB-ESS Grid Enhancement Project PacifiCorp, Castle Valley, Utah

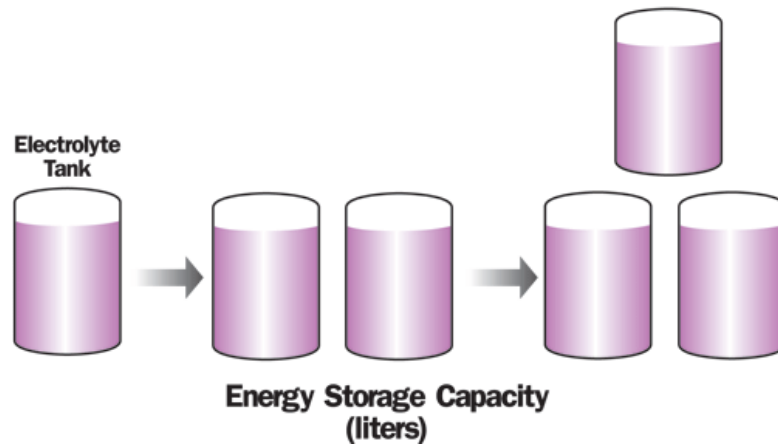
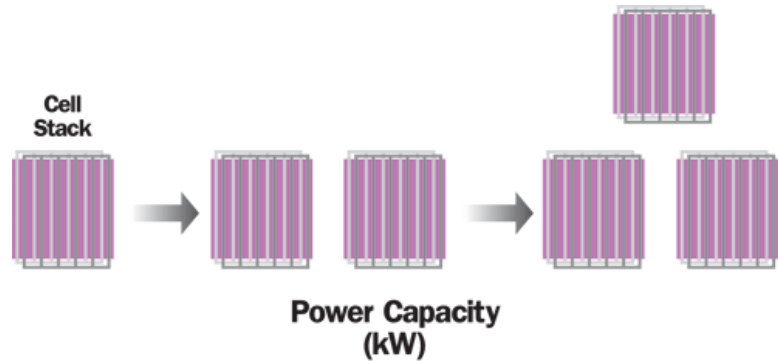
Almost 5 years successful operation



Inside the 2MWh PacifiCorp installation in Moab



VRB Technology – the evolution - Scalable / Flexible



- 5kW – 10MW
- Prudent Energy controls worldwide patents*
(*excludes Japan)



Original concept - Built on site



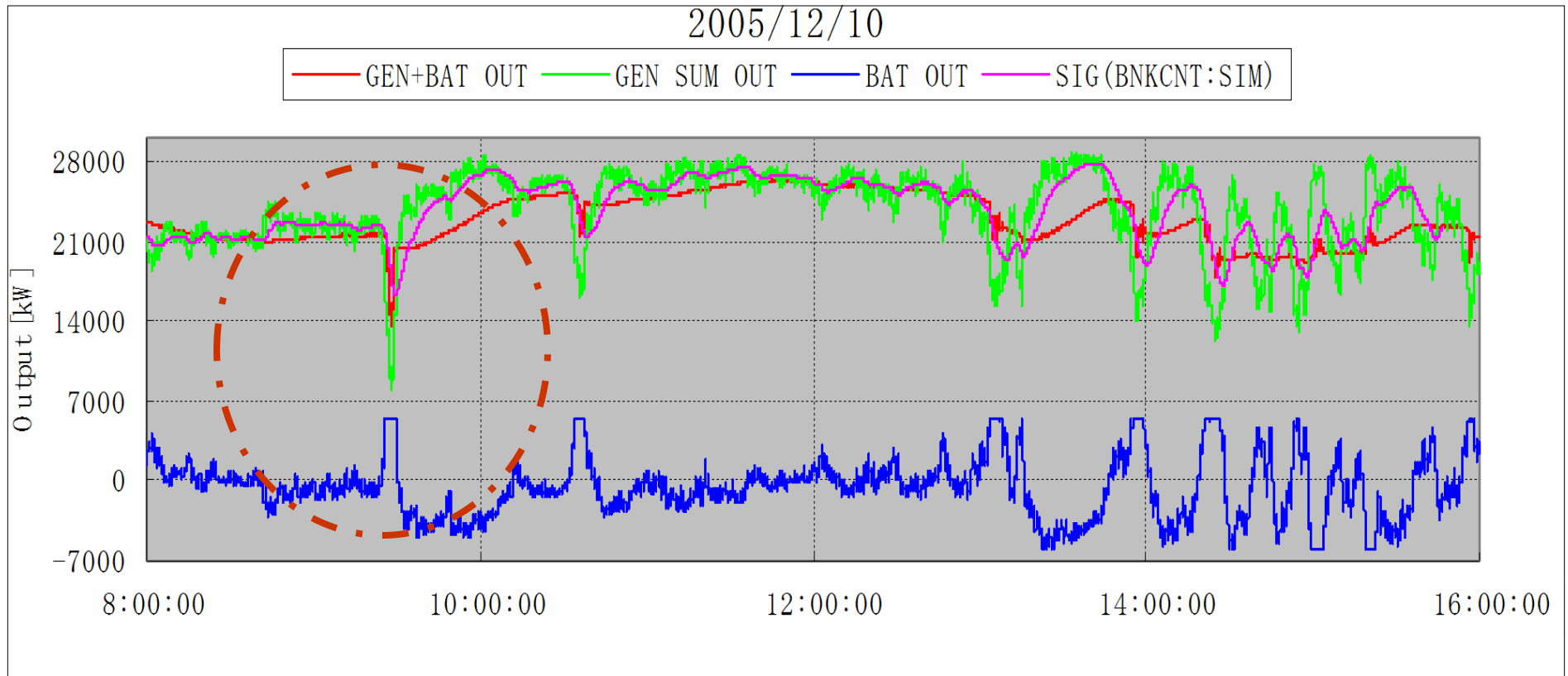
Current systems - Modular Packaged

Renewables – VRB-ESS™ Proven with wind



- 4MW x 1.5 hour (50% pulse factor) VRB-ESS Grid-Coupled Wind Smoothing Tomamae, Japan
- One of several Sumitomo VRB-ESS installations in Japan
- 270,000 cycles in 3 years

Daily Wind Output Smoothing - Japan



- The VRB-ESS (blue line) runs continuously to smooth wind farm production (green line).
- At only 20% of the wind farm's nameplate capacity, the VRB ESS has a significant smoothing effect to total wind farm + battery output (red line)
- The VRB-ESS intelligently recharges throughout the day so that it maintains 50% SOC

Cost Reduction – Profit Center

Demand Shifting: Charge ESS at night in Summer, provide power during the afternoon, reduce peak demand.

Demand Response: Utility and CAISO programs that pay you to curtail power. Use ESS for electric source and curtail power at meter.

Emission Credits: Replace diesel BUG or on-site generation.

Reduced Nuisance Trips: Scrap and Downtime.

Sell Capacity to CAISO: California Grid Operator pays for frequency regulation, short time energy sales, power balancing caused by intermittent renewables – wind and PV.

CAISO

Integration of Renewable Resources, Nov. 2007

- “Storage facilities can provide a number of benefits that will help with the integration of large amounts of renewable resources.**
- “Storage provides a mechanism for saving off-peak energy production from wind generation and delivering the energy during on-peak periods.**
- “Some storage technologies can also provide Ancillary Services such as regulation and contingency reserves and reactive power for voltage support.”**

“The California ISO plans to work with the IOUs, stakeholders, and potential providers of storage technology to design market products that properly compensate owners of storage facilities for the benefits they can provide.”



Incentives and Rebates

Up to 90% of Cost!

SGIP: Up to \$2.40 per Watt (\$2,000 kW) from the Self Generation Incentive Program.

- » Must be associated with onsite wind or fuel cell generation only.

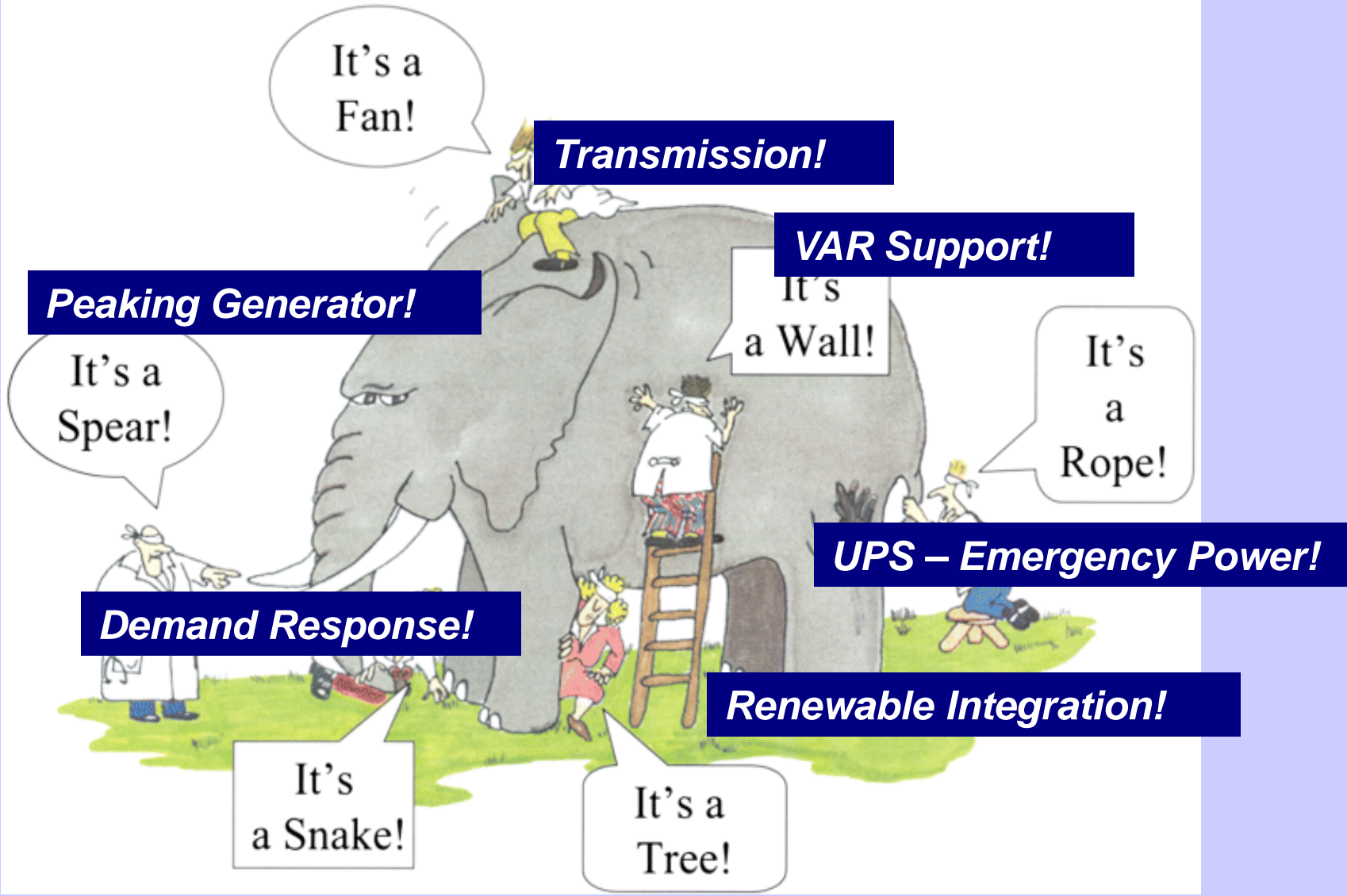
ITC: 30% cash grant when integrated with any Investment Tax Credit eligible technology; fuel cells, wind, solar, cogeneration, biomass / biogas / biofuel, etc.

Smart Grid Grants: Stimulus legislation, the American Recovery and Reinvestment Act (ARRA) provides 50% matching funds.

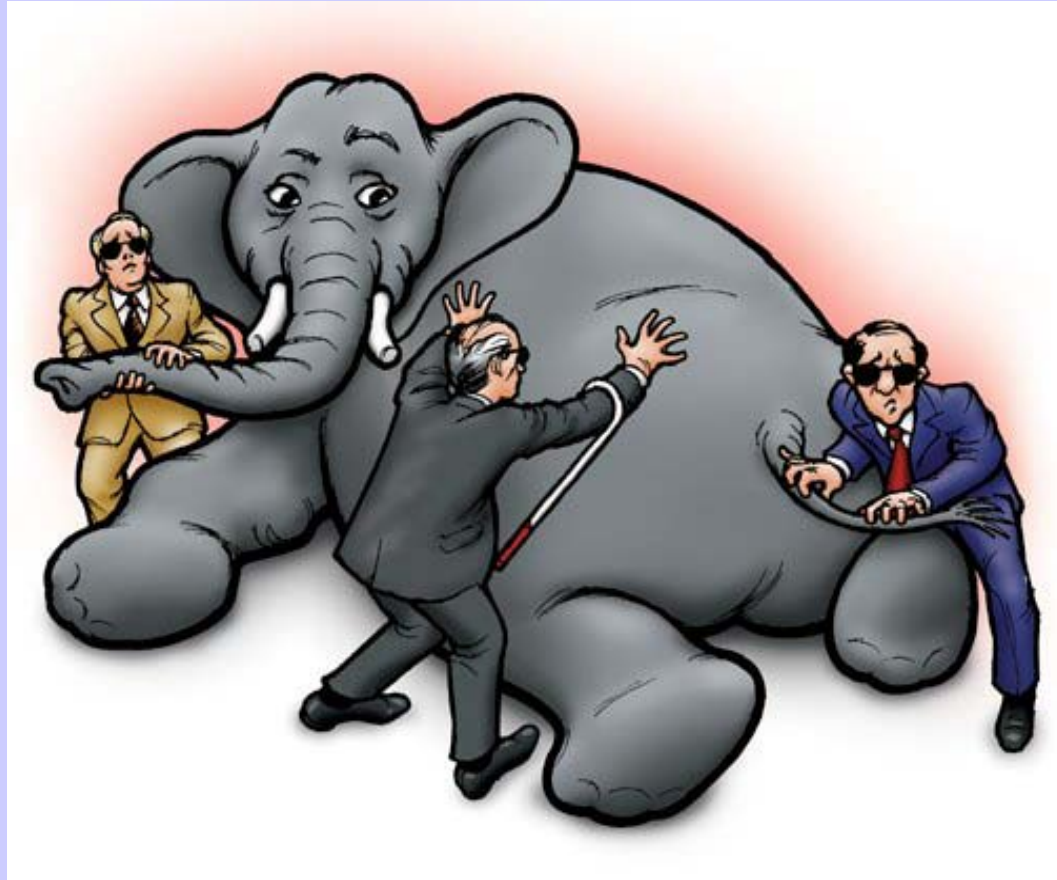
Pending Legislation:

- » US Senate: 20% tax credit for stand alone ESS.
- » California Legislature: Rebates, tax incentives for stand alone.

How is Energy Storage like an Elephant?



Where do you want to start?



www.Utility-Savings.com

