Evaluating Value Propositions for Four Modular Electricity Storage Demonstrations in California

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by

Distributed Utility Associates, Inc.

Jim Eyer, Senior Analyst

jim@dua1.com

Susan Horgan, President

susan@dua1.com

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Agenda

- Scope
- Background
- Assessing Value Propositions
- Supercapacitor for Sacramento Light Rail
- Supercapacitor for Load & DG Integration
- Flow Battery for T&D Deferral
- Flywheel for Area Regulation
- Outlook

Scope

- DOE ESS partnership with CEC/PIER
  - innovative electricity storage demonstrations in California that are sponsored by CEC/PIER

- DUA: Evaluation and Report
  - ✓ Value propositions (benefits > cost?)
  - ✓ Economic market potential (MW cost-effective capacity and $)

Background

- Framework to evaluate demonstration proposals
  - ✓ emphasis on *value proposition*
  - ✓ using consistent financial bases
- DUA provides a third party “audit”
  - of financials, economic market potential

☞ ERPI/PEAC to monitor performance and gather data used to confirm benefits

Assessing Value Propositions

- Reconcile performance data (EPRI/PEAC) with relevant “price” or avoided cost
- Calculate Net Benefits ($)
  – revenues ($) minus operating cost ($)
- Compare to Plant “Carrying” Cost
- *Cursory* Estimate of “Economic Market Potential”

  - Capacity (MW) - Value ($Millions)

Supercapacitor for Sacramento Light Rail

- Relieve overloading on a key rail line
  - reduce Voltage sags
  - increase capacity (train length & frequency)
- Benefits ($ TBD)
  - ✓ avoided/deferred transformer addition
  - ✓ recouped energy (regen-braking)
  - ✓ avoided service outages
  - ✓ reduced drivetrain and contactor wear
  - ✓ add express service
  - ✓ improved ride for customers

Supercapacitor for Load and DG Integration

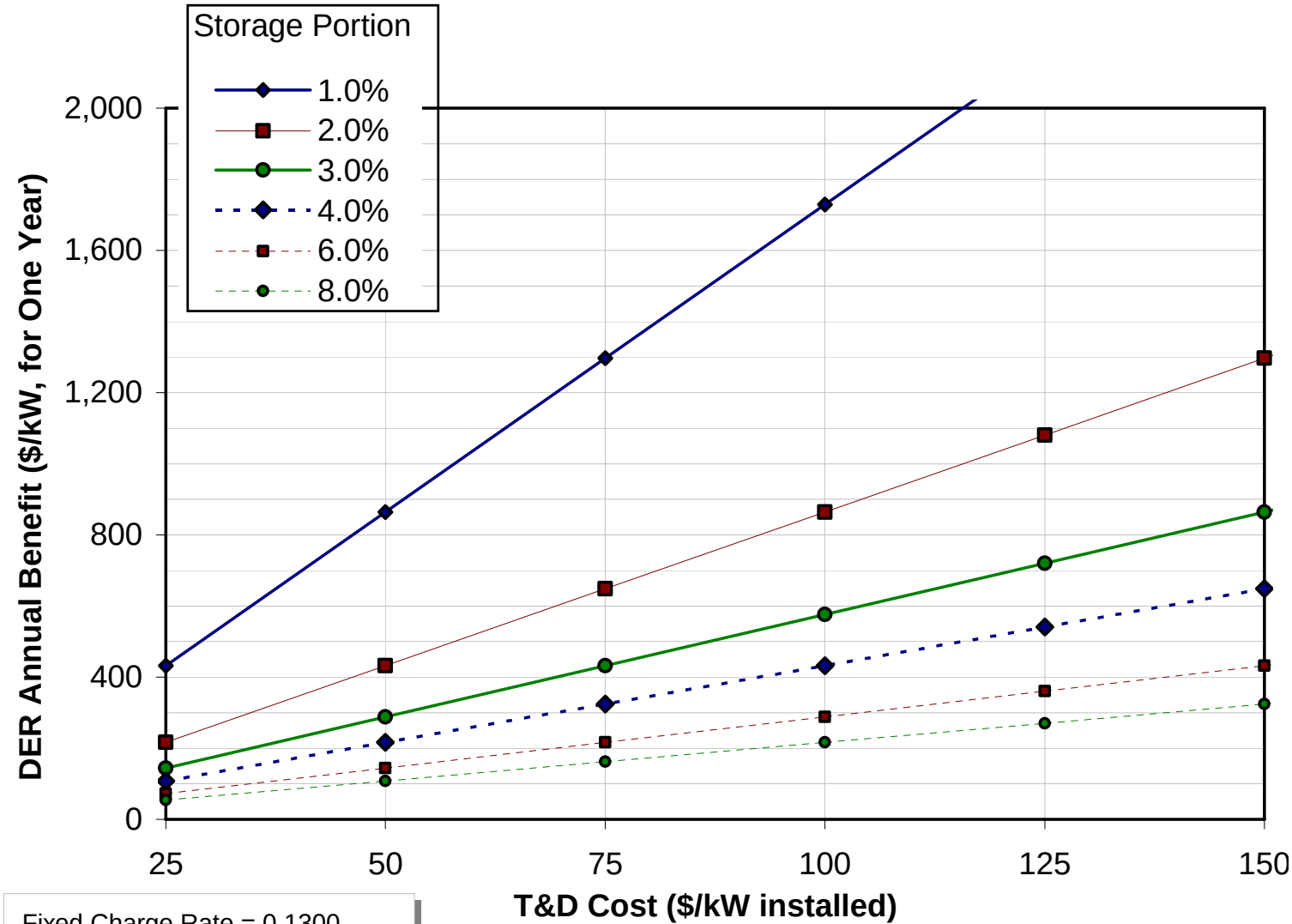
- Palmdale Water District; water treatment.
- Maxwell, 450 kW, ~20–60 seconds
- An element of a system with DG, power conditioning, switching, controls
- Loads + fossil-fueled gen. + wind gen.
- Benefits (to be quantified) related to:
  - ✓ superior load transfer (to on-site gen.)
  - ✓ reduced cost for on-site gen. operations

Flow Battery for T&D Deferral

- Zinc bromine battery system by ZBB
- “Acceptance Testing” underway @ DUIT/PG&E
- Candidate sites: TBD
- Benefits: $100/kW-year or more
  - Several times more for “good” locations

✓ high T&D cost
✓ high adder benefits
✓ slow load growth
✓ uncertain load additions
✓ modest storage needs (kW, kWh)
✓ “peaky” load profile
✓ *DG* emissions constrained
✓ limited construction resources

T&D Deferral Benefit ($)



Fixed Charge Rate = 0.1300
T&D Upgrade Factor = 0.33

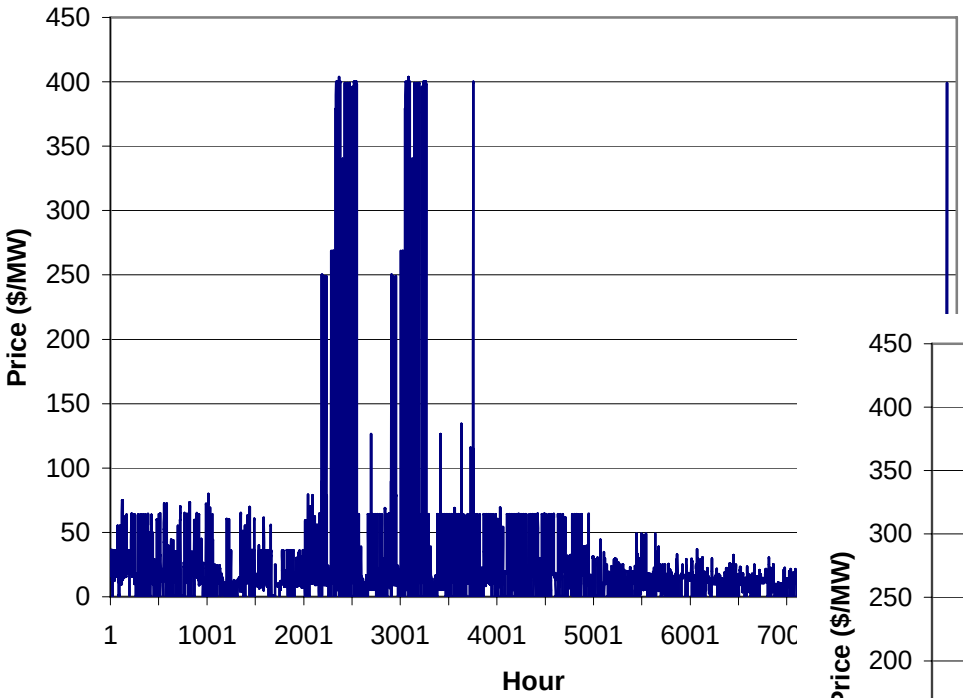
Flywheel for Area Regulation

- Reconcile momentary difference between supply and demand within a region (ISO)
  - "up regulation" for supply *deficit*
  - "down regulation" to offset *excess*
  - separate prices for up and down (in California)
- From derated, "slow" thermal generation
- Flywheels: discharge for up, charge for down
  - can vary output and/or input "very rapidly"

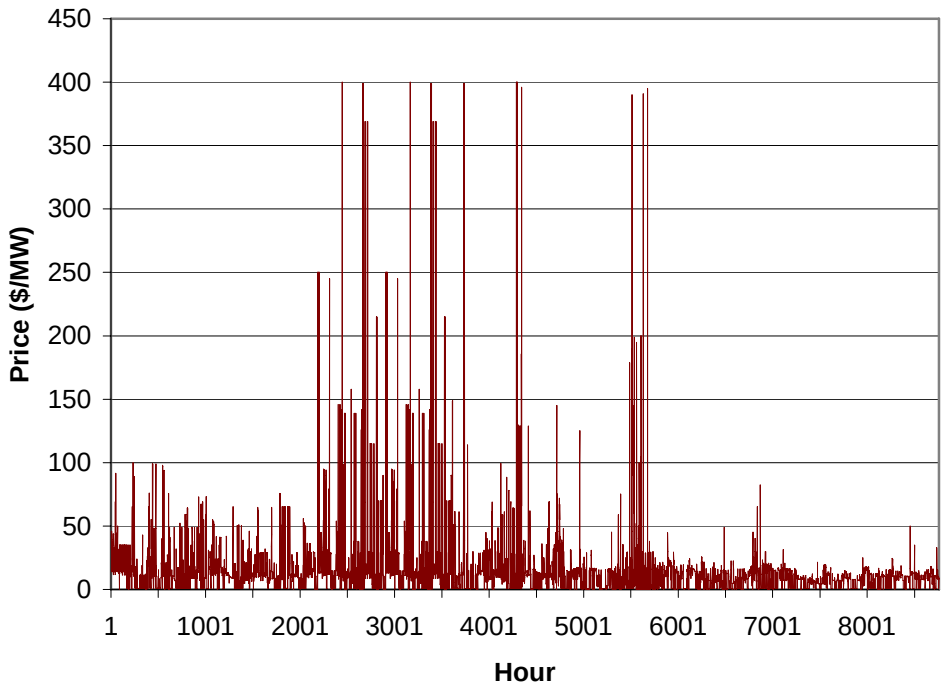
  ☞ 15 mins. storage: not enough energy 2% to 3% of time

Flywheel for Area Regulation

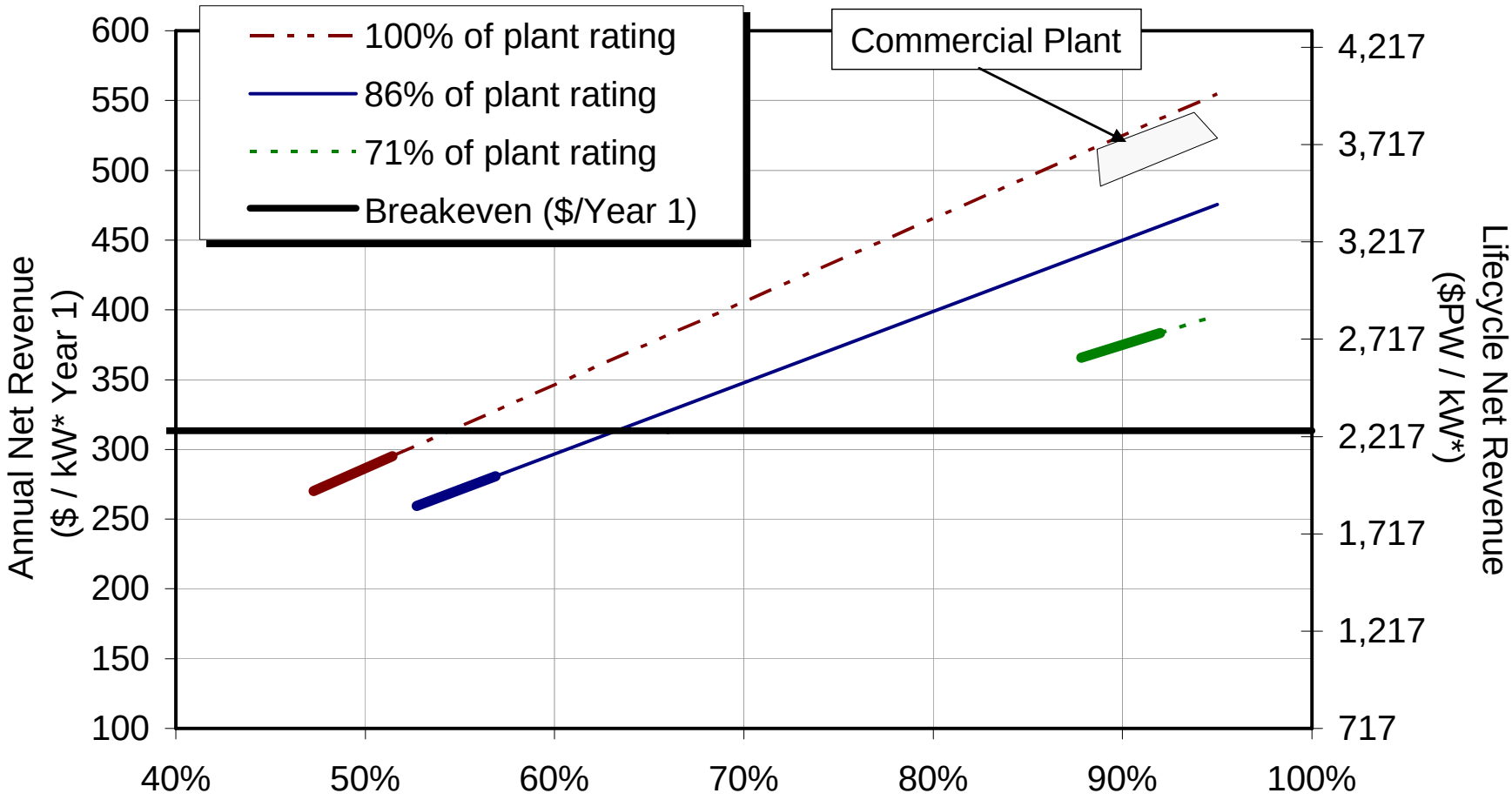
Up Regulation Price



Down Regulation Price



Flywheel for Area Regulation



*Per kW of plant rating.

Outlook

- Supercapacitor for Sacramento Light Rail
  - testing and operation 2008
- Supercapacitor for Load/DG Integration
  - testing and operation 2008
- Battery for T&D Deferral
  - testing 2007, operation 2008 - 2009?
- Flywheel for Area Regulation
  - 20 MW commercial plant in California