SDG&E's Energy Storage Implementation

DOE – Energy Advisory Committee

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Existing Substation Energy Storage Projects

- 2 units (1 MW / 3 MWh) installed and in production

Location	Size (kW/kWh)	Mfg/Integrator	Status	Purpose
Borrego Springs Microgrid	500/1500	Saft/Parker Hannifin	Production	Peak Shaving, Time Shifting, VAr Dispatch, Island Support, PV Smoothing
Pala Substation	500/1500	Greensmith	Production	Time Shifting, VAr Dispatch, PV Smoothing

Existing Community Energy Storage Projects

- 12 units (260 kW / 391 kWh) installed with 7 in production

Location	Qty	Size (kW/kWh)	Mfg/Integrator	Status	Purpose
STC, Clairemont, Poway	3	25/72	Saft/ Powerhub	Installed, technical evaluation	PV Smoothing, Peak Shaving, VAr Dispatch
Borrego Springs	3	25/50	Greensmith	Production	PV Smoothing, Peak Shaving, VAr Dispatch, Islanding
Century Park	1	50/82	Greensmith	Production	PV Smoothing, support for EV chargers
San Diego Zoo	1	100/100	PPS/Kokam	Production	PV smoothing, VAr support, schedule charge/discharge
UCSD MESOM	1	6/11	Sunverge/ Kokam	Production	Support for EV chargers, mitigate demand charges, synchronize energy storage with PV array
SDSU Suites	1	18/32	Sunverge/ Kokam	Production	Support for EV chargers, mitigate demand charges, synchronize energy storage with PV array
Santa Ysabel Microgrid	2	30/34 and 6/10	Saft and Sunverge	Production	Power smoothing for wind generation in support of islanding critical assets

Planned SES Projects

- 5 units (5 MW / 14 MWh) contracted Q4 2012, to be installed by Q2 2014
- Worked with Distribution Planning to identify locations SES would provide an alternative to traditional solutions

Location	Size (MW/MWh)	Mfg/Integrator	Status	Purpose
Borrego Springs Unit 2	1/3	Saft	Site testing Operational	Peak Shaving, Time Shifting, VAr Dispatch, Island Support, PV Smoothing
C1243 (Ortega Hwy)	1/3	Greensmith	Installing	Peak Shave, Time Shifting, VAr Dispatch, Islanding
C75 Mt San Miguel	1/3	Greensmith	Installing	Reliability, Islanding, Power Quality
Julian	1/2	S&C	Installing	Reliability, Islanding, Power Quality
North City West – Canyon Crest Academy	1/3	Saft	Installing	PV Smoothing, Power Quality, Islanding

Community Energy Storage (CES)

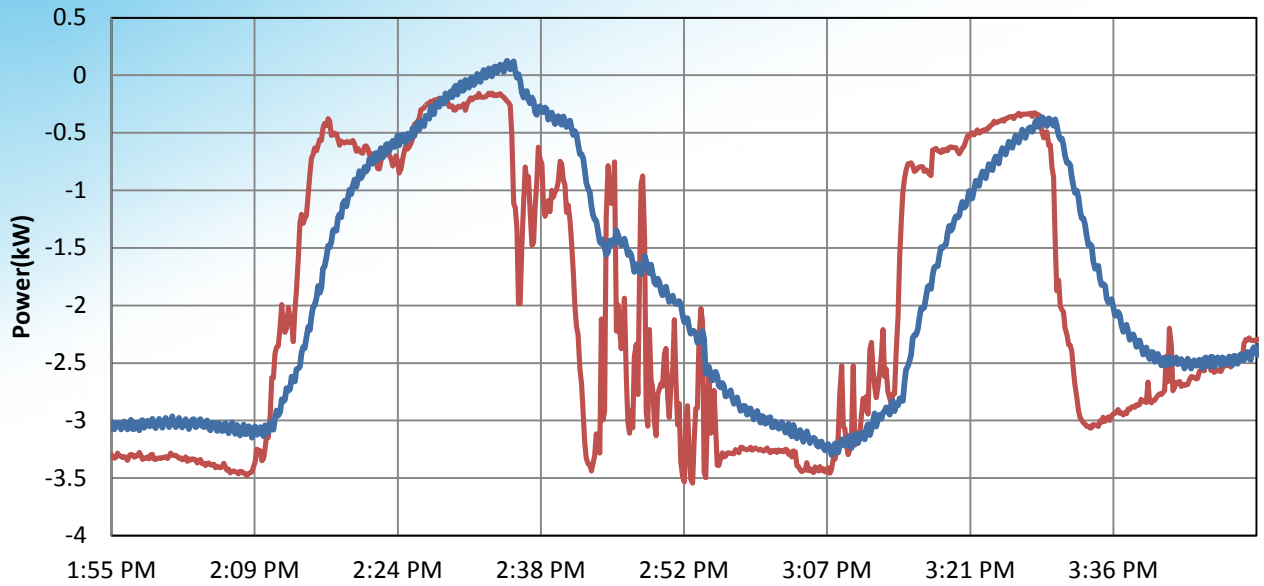
- Three Units
- 30 kW, 72 kWh Each
- Saft Lithium Ion Batteries
- Powerhub Inverter and Cabinet
- 120/240 V Single Phase
- Current Uses
  - Ad-hoc testing (Skills)
  - Daily peak shaving (Clairemont)
  - Temporarily offline for repair, previously used for PV smoothing (Poway)

Borrego Community Energy Storage (CES)

- Three Units
- 25 kW, 50 kWh Each
- 120/240 V Single Phase interconnection
- Kokam Lithium Ion batteries
- S&C Inverter and Cabinet
- Currently Online and available for:
  - Islanding
  - Constant Output
  - Peak Shaving
  - Arbitrage
  - PV Smoothing
  - VAr Dispatch

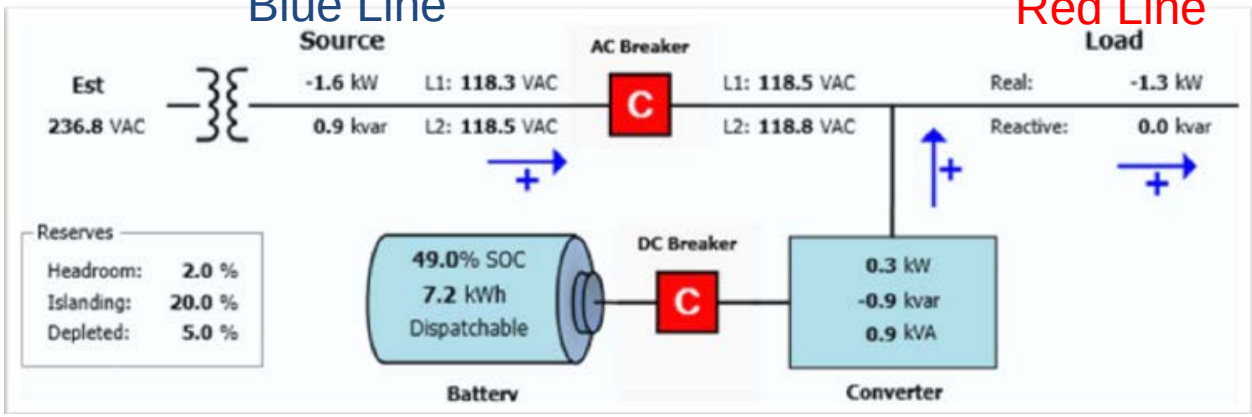
CES PV Smoothing Operation

- Units capable of smoothing intermittency caused by fluctuating power output
- Operational variables can be user-defined i.e. Ramp rate control, time constant



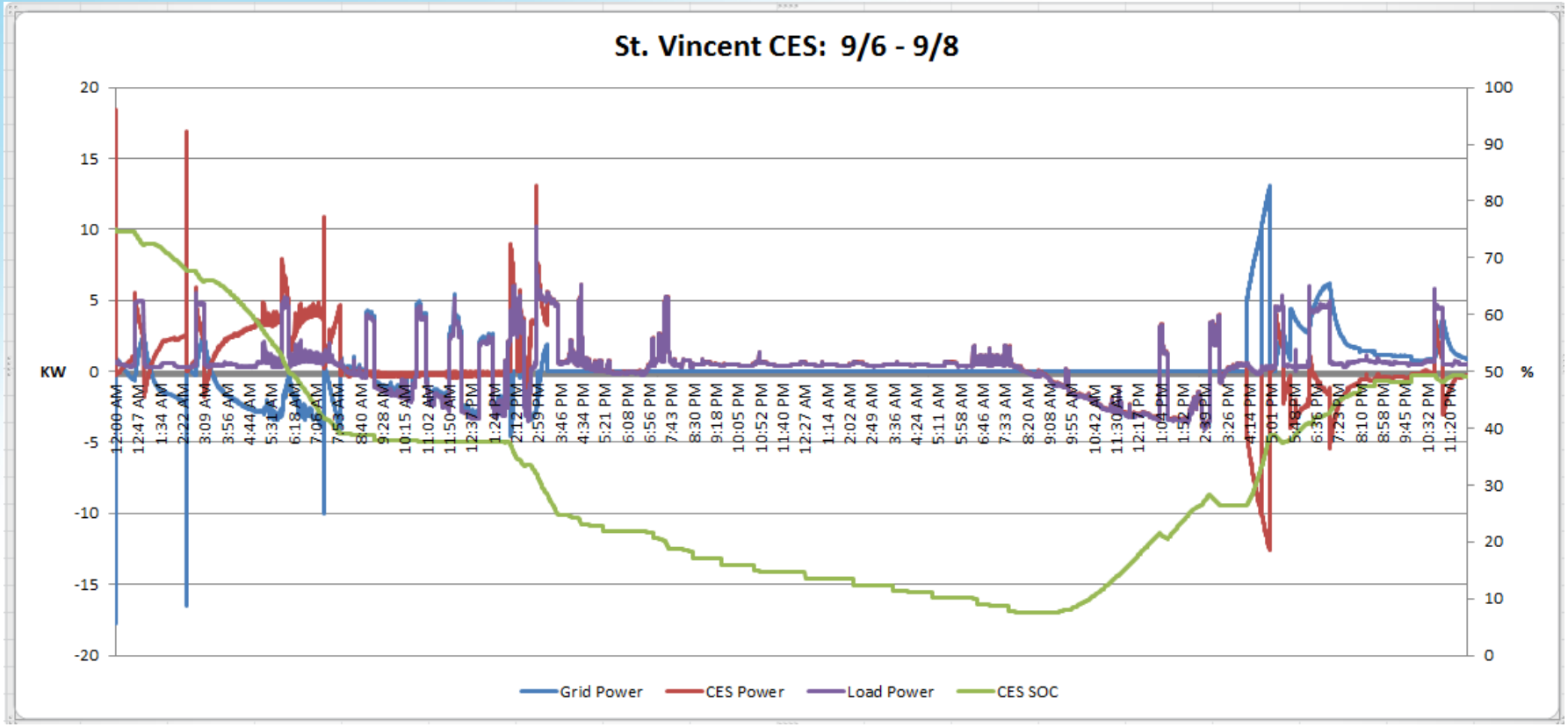
Blue Line

Red Line



CES - Borrego Flood Outage 9/6-7

- No outage seen at St. Vincent CES unit site



Procurement Issues

- Limited market availability, long lead times, extended supply chains
- "Turnkey" contracts do not cover all work/costs required for commissioning
  - E.g. land, environmental, site preparation, electrical interconnection / upgrades, software integration
- Vendor financial strength inconsistent
- Some vendors exaggerate their capabilities
  - Systems not ready to be commercially deployed (e.g. Flow battery used to model / forecast GRC storage projects, but not actually available on a commercial basis)
  - Inability to perform full Factory acceptance test (e.g. full power test, PV smoothing test)
- Some vendors are unable to offer full "turnkey" projects
- Some vendors refuse to provide hard quotes (they offer budgetary estimates, subject to extras)
- Most vendors do not offer extended warranties – those that do, are they going to be around? Is capacity degradation covered (usually not)?
- Usable capacity of battery systems is 10-20% less than nameplate capacity (cells cannot be discharged to 0%)

Design / Engineering Issues

- No validated models to size capacity & duration of units
  - What do you need, and where, for what application[s]?
- Large, heavy units require significant space and civil/structural engineering (concrete pads, retaining walls, etc.)
- Lack of utility construction standards
  - SDG&E is developing these for our service territory – e.g. requiring a SCADA switch in front of each large battery system
- Cooling requirements can be significant if the units are in operating areas with high ambient temperatures (15kW to 30kW common for 500 kW system).
  - Passive vs. active cooling: passive requires additional space, active requires additional equipment and associated maintenance, and electrical demand
- Noise considerations if units are installed in populated areas. Inverters operating at high kW levels can produce a loud, high-frequency sound.
- Safety, environmental and permitting issues

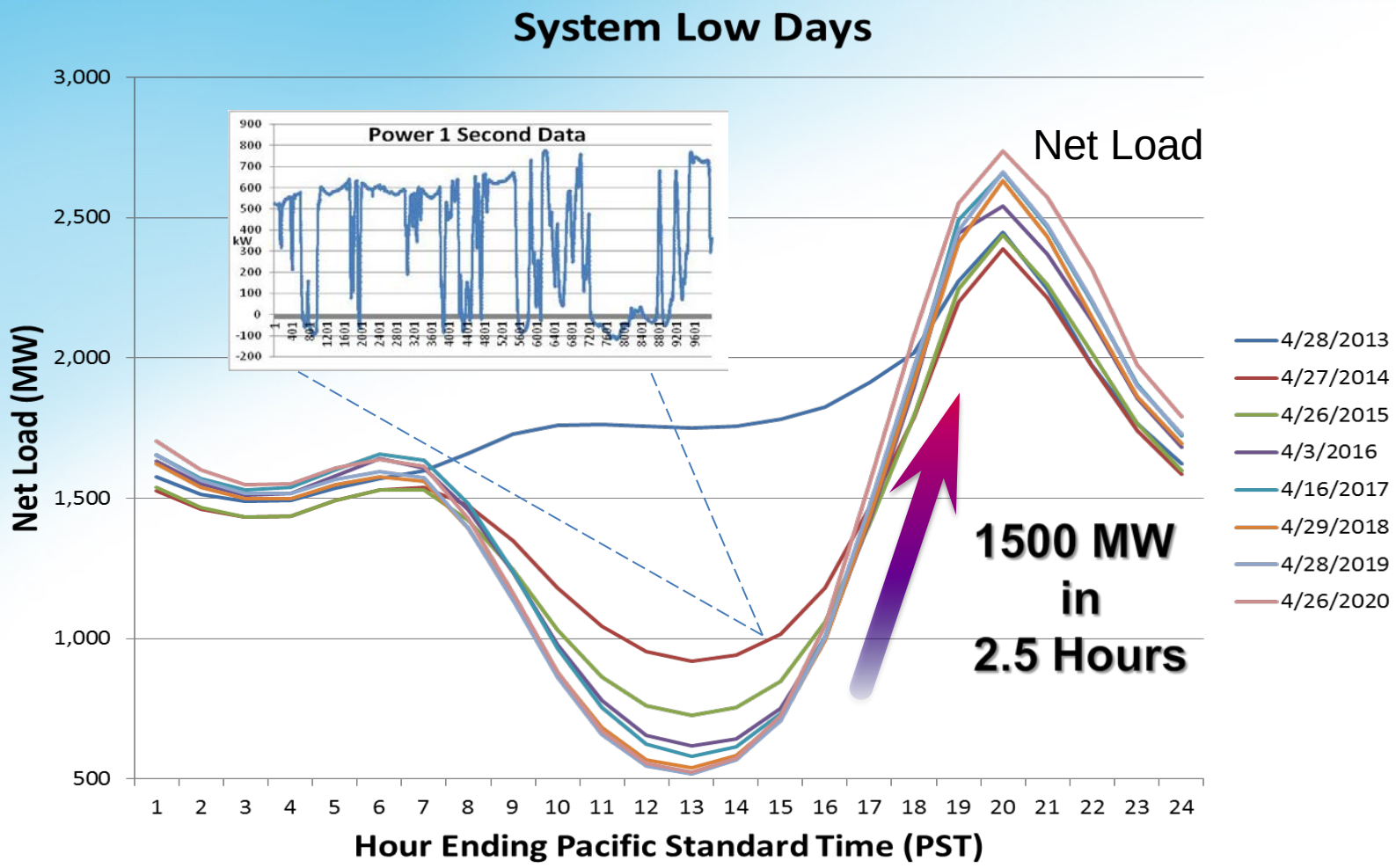
Construction / Installation Issues

- Physical
  - Battery yards require walls or fences, possibly sound barriers
  - Battery yards need to be large to accommodate (equipment, working space, ingress/egress, cranes), similar in many respects to a substation
  - Battery containers require large concrete pads or piers; seismic requirements must be met
  - Environmental restrictions – e.g. species protection, materials used in equipment, storm water runoff
  - Large footprint for minimal MW, MWh – easement and other right-of-way issues
- Electrical
  - Large batteries require SCADA switches for quick isolation (increases cost, complexity)
  - Some battery systems require non-standard transformers
  - Some installations require non-standard cables that are flexible enough to be trained inside the inverter cabinets (e.g. those used on hybrid locomotives that support a very tight bend radius)
- IT
  - Communication requirements, availability, reliability
  - Hardened, reliable secure environments are required

Operations Issues

- Lack of integration between network management systems (OMS/DMS, IT network systems) and battery controls / element management systems
  - New functions and interfaces
- Cloud based web-portal or other custom control systems for each vendor
- Immaturity of integrated solutions
- Communications between systems sporadic
  - E.g. local communications between devices (battery/PCS), and backhaul to utility
- Vendor support – some vendors more responsive than others
  - Spare parts, repairs, software fixes
- Scaling of solution is non-trivial – not as simple as just adding more modules
- Failure modes are different for each solution / vendor
- Fire protection / suppression requirements for lithium-based chemistries are significant

Net Load and Flexible Capacity Needs – SDG&E



Questions?

SDGE connected
A Sempra Energy utility

Thank You

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www.sdge.com/smartgrid/