Solar Plus Storage
Focus on Storage Benefits
NEM3 (NBT) Edition

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Getting to 100% renewables

- We cannot get to 100% renewables without energy storage
- Solar+Storage
- Wind+Storage

Rate Increases – EV2

EV2	2020	2025	Increase	delta peak-offpeak
PG&E				
Summer	Rate			
Peak	$0.48179	$0.62277	29.3%	
Part Peak	$0.37130	$0.52655	41.8%	
Off Peak	$0.16928	$0.32454	91.7%	$0.29823
Winter				
Peak	$0.35467	$0.49566	39.8%	
Part Peak	$0.33798	$0.47896	41.7%	
Off Peak	$0.16928	$0.31027	83.3%	$0.18539

Rates slightly DECREASED from 2024 to 2025.

Rate Increases – TOU-D

E-TOU-D	2020	2025	change %	delta peak - offpeak
PG&E				
Summer	Rate			
Peak	$0.36475	$0.57149	56.7%	
Part Peak	$0.00000	$0.00000		
Off Peak	$0.26980	$0.43653	61.8%	$0.13496
Winter				
Peak	$0.29089	$0.48189	65.7%	
Part Peak	$0.00000	$0.00000		
Off Peak	$0.27351	$0.44328	62.1%	$0.03861

Rates slightly DECREASED from 2024 to 2025.

Existing Solar/battery customers
Which rate is better?

- Do you use a LOT of off-peak power, charging EV? Do you have a battery to do arbitrage?
  - Yes – Use EV2 rate
  - No – Use TOU-C or D
- Why? TOU-C/D rates during the MAIN solar hours (generally off-peak) are HIGHER than the EV2 rate, so exported solar has higher value than EV2.
- Best – run comparisons with models – download PGE green button data for a year, run through models.

Best Options under NBT

- You have existing solar-
  - Add battery storage – you still can get NEM2 values
- Add solar+storage
  - Solar+Storage if done properly can save substantially under NBT – simple payback in as little as 7.6 years (even faster with an EV)

Whole Home Solar+Battery Power

10kw - 22 450 watt bifacial PV modules

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Whole Home Solar+Battery Power

18kw inverters – 2 Sol-ark 12s plus 200A ATS – 45kwh LFP energy storage in 3 15kw blocks.
100A Grid service – 200A home service – all electric home

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Whole Home Solar+Battery Power

15kw inverter – 1 Sol-ark 15 (200A ATS built in) – 15kwh LFP energy storage. 100A Grid service – 200A home service. 5.8kw PV. Cellular monitoring

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Whole Home Solar+Battery Power

5.8kw PV – Custom Power Solar ballasted flat/sloped roof mount system – no roof penetrations

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Whole Home Solar+Battery Power

27kw inverters – 3 Sol-ark 12s plus 400A ATS – 90kwh LFP energy storage in 6 15kw blocks.
Add on to existing microinverter solar home

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Value of Solar+Storage

- All Electric Home with EV
- 10kw Solar + 30kwh Storage – whole home backup
- Cost – raw cost $53,000 installed
- $37,100 after tax credits
- Cost savings from utility savings - $4,910/yr
  - Solar value is only $2240/yr
  - Storage value is $2670/yr only 4% cycle life used
- Simple Payback – ***7.6 years***
- PV - $3.50/watt
- Storage - $600/kwh
- Generates 18,000kwh/yr
- Saves over 7 tons of GHG/yr (not including EV savings)
- Home runs on solar during the day, storage at night
- Exports excess solar to grid
- Battery typically filled by noon from solar

Storage Savings per kwh

- Assume 20 year life
- $2670/yr cost savings *20 = $53,400 – even assuming no rate increases, which would increase savings – at 3% average rate increase per year, value would be $71,744
- 30kwh battery system - $/kwh of savings is $1780/kwh, $2391/kwh including 3% rate increases

Overview storage products

- Lead-acid
- Lithium ion
  - Nickel Cobalt Manganese (NCM)
  - Nickel Cobalt Aluminum (NCA)
- Lithium Iron Phosphate (LFP)
- Lithium Titanate (LTO)
- Flow Batteries
- Coming – Solid State
- New – Sodium Ion

Lithium Iron Phosphate Batteries

- Lithium Iron Phosphate (LFP)
- 96-98% efficiency
- 3000-10,000 cycle life
- High DOD (80%+)
- 3.2-3.6V/cell
- -20 to 60C operating temperature
- Much lighter weight than lead-acid
- Discharge under 0C, but typically no charging under 0C without heaters

- Safer, better fire resistance than Li-ion
- Tend to allow inverters to operate more efficiently
- Typically can last 10+ years
- CATL now offers 15yr warranties
- Limiting to 80% DOD extends life

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Sodium Ion Batteries

- 10,000 cycle life
- -40 to 70C operating temperature
- Similar energy density as LFP
- Discharge even 90% of capacity down to -40C
- Working voltage range 2.0-4.0V
- High charge rate up to 12C (Naxtra)
- Safer, no fire with puncture
- Can be shipped at 0V – no discharge possible for safety
- Typically can last 10+ years
- CATL now offers Naxtra

Value of Storage Batteries

- To evaluate batteries, calculate the actual lifetime dollars per kWh ($/kwh)
  - Typical lead-acid – $350/kwh / (1500 cycles * 50% DOD * 70% RTE1) = $0.67/kwh
  - Lithium - $500/kwh / (5000 cycles * 80% DOD * 85% RTE1) = $0.15/kwh
  - Lithium is 4X+ the value of lead-acid

1 RTE – Round Trip Efficiency = one way efficiency squared – includes inverter efficiency

Value of Storage Batteries

- Another way to evaluate batteries, calculate the actual lifetime dollars per kWh ($/kwh) per the mfg warranty
  - Example: Lithium - $500/kwh / (3500 cycles * 80% DOD * 85% RTE1) = $0.21/kwh
- Mfg now sometimes refer to cycle life in Mhw – capacity * cycles, example – 3500 * 15kwh = 52.5 Mwh.

1 RTE – Round Trip Efficiency = one way efficiency squared – includes inverter efficiency

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Cycle Life vs Calendar Life

- Cycle life is the total amount of charging and discharging – more total charging/discharging reduces available capacity. Cycle life is typically measured to point where battery has 70-80% of original capacity.
- Calendar life is point where battery loses capacity just by existing. Life is shortened if battery is subjected to higher temperatures. Calendar life is typically measured to point where battery has 70-80% of original capacity. Calendar life is also affected by SOC. SOC above 80% tends to reduce calendar life.

Value of Storage Batteries in Cost Savings

- Arbitrage – moving energy from low rate periods to high rate periods
  - Highest value when high delta off-peak rate vs peak rate
- Self-supply – using stored solar power to run onsite loads
- Export at high value – export stored energy from solar during high value grid periods
- Demand Reduction – reducing the peaks of energy usage spikes = reducing demand charges
- Backup – prevent loss of assets when grid fails
- Virtual Power Plants (VPP) – systems in these programs discharge when needed by the grid.
  - Emergency Load Reduction Program (ELRP) - $2/kwh during peak events
  - Demand Side Grid Support (DSGS) - pays a fixed amount per kw delivered, provided deliver for all events. $64.55/kw over 6 months

Sizing Battery Systems

- Depends on application
- For Backup: Find the annual energy use in kwh. Divide by 365. Example home 8000kwh / 365 = 22kwh – this is the minimum amount needed to get from one day to the next. With solar, during the day battery will be recharged, plus offsetting loads. So actual amount used may be somewhat less.
- As systems come in block sizes, round up to next higher size. Example block size 14kwh, next size up is 14*2=28kwh

Shift to All Electric

- Over 50 cities have future bans on natural gas
- Some cities already have bans on installation of new gas hookups
- Shift away from gas furnaces and heaters – no gas heaters sold after 2030
- State shift to all electric vehicles
- Climate goals to net-zero by 2045

All Electric Homes/Businesses

- Heat pump heating, cooling, water heaters
- Induction stoves
- Electric dryers (some heat pump versions)
- All-electric vehicles
- Solar+storage generation

Heat Pump Examples

Mini split heat pump heating/cooling inside and outside units

Heat pump hybrid water heater

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All Electric Home Example Costs

- 1500 sqft home 4 occupants
- Heat pump heating, cooling - $15-25k installed
- Heat pump water heater - $3-5k installed
- Induction stoves – from <$100 for single to $2k for full stove
- Electric dryers (some heat pump versions) $1-1.5k
- Heat pumps 2-3X more efficient than gas
- All-electric vehicles – Bolt $27k Tesla M3 - $45k
- Rebates available

All Electric Home Example Costs

- 1500 sqft home 4 occupants
- All except EV - $21k-34k
- Solar+storage generation 10kw+30kwh savings $4,910/yr – simple payback 7.6yr with EV 5.2yr
- Including all electric appliance cost simple payback 11-13yr with EV 8-9yr

All Electric Home
Green House Gas Savings

- 1500 sqft home 4 occupants
- Including EV use 12,788 kg (28,192 lbs) GHG saved PER YEAR
- 7065 kg saved from solar generation
- 5723 kg saved from EV use
- Going all electric with solar+storage+EVs is

THE most effective way individuals can effect climate change

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Upgrading 100A service to 200A service

- Often older homes are only 100A service. Upgrading the service entrance wiring to 200A from the utility can run $6000+. But upgrading the service entrance wire from utility to 200A is NOT needed. Solar+storage provides a lower cost solution.
- Sol-ark solution provides a 200A transfer switch, up to 62A of ADDITIONAL power, plus the 100A existing service to power a NEW 200A main panel. The existing 100A panel connections can be left in place.
- Solar+storage with whole home backup + 200A service upgrade WITHOUT the extra cost of a utility service upgrade

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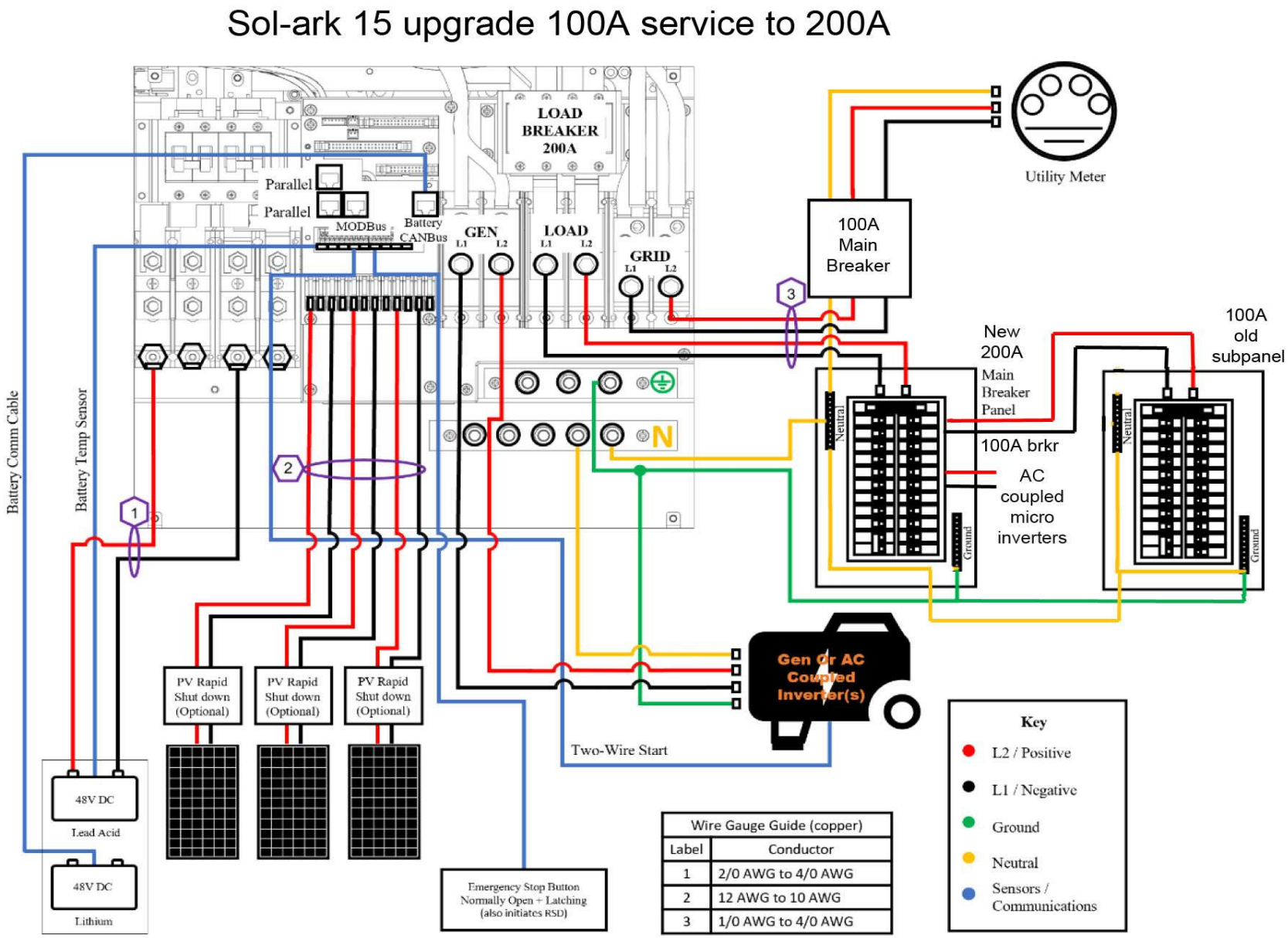
Upgrading 100A service to 200A service



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Finance Options

- Cash - is king for contractors
- Home owner
- Equity Line Of Credit (HELOC)– 3 - 5% typical rate
- PACE funding – payments go on property taxes, 0% down, terms up to 25 years
- GoGreenFinancing.com – useful tools to assess many energy improvement projects with financing resources

NEM3 (NBT)

- All new applications go under NBT now being called NBT
- Any ***usage*** billed at TOU rate.
- ANY ***exports*** credited at value based on Avoided Cost Calculator, with different values for every hour, monthly basis, and weekends different than weekdays.
- Except for narrow window in summer 5-10pm, these values are MUCH lower than retail rates – average $0.10/kwh
- During solar peak, average is even lower - $0.06/kwh – under $0.03/kwh in spring

NBT – weekday export value 2025

		Total Export Rates - Weekdays											
		2025 Base Rates (no adders)											
Hour of Day		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
	1	0.090	0.086	0.069	0.075	0.075	0.079	0.075	0.086	0.092	0.089	0.087	0.089
	2	0.088	0.084	0.069	0.074	0.071	0.074	0.072	0.088	0.089	0.087	0.086	0.085
	3	0.086	0.084	0.068	0.075	0.071	0.073	0.068	0.085	0.086	0.084	0.084	0.082
	4	0.086	0.084	0.067	0.074	0.071	0.076	0.067	0.080	0.084	0.083	0.083	0.082
	5	0.087	0.085	0.068	0.071	0.072	0.075	0.066	0.080	0.083	0.081	0.086	0.085
	6	0.092	0.084	0.071	0.073	0.069	0.077	0.067	0.081	0.085	0.084	0.087	0.089
	7	0.092	0.080	0.072	0.070	0.065	0.076	0.071	0.078	0.084	0.083	0.083	0.090
	8	0.088	0.076	0.070	0.065	0.060	0.071	0.065	0.069	0.071	0.075	0.072	0.083
	9	0.073	0.055	0.049	0.018	0.029	0.055	0.060	0.064	0.063	0.064	0.064	0.074
	10	0.065	0.043	0.023	0.011	0.016	0.045	0.052	0.063	0.061	0.059	0.061	0.069
	11	0.062	0.038	0.016	0.010	0.012	0.042	0.055	0.063	0.060	0.059	0.061	0.069
	12	0.061	0.038	0.019	0.011	0.016	0.041	0.053	0.062	0.060	0.059	0.060	0.063
	13	0.060	0.034	0.015	0.012	0.013	0.039	0.053	0.061	0.059	0.058	0.060	0.063
	14	0.058	0.032	0.018	0.008	0.009	0.044	0.050	0.062	0.059	0.057	0.058	0.061
	15	0.057	0.031	0.021	0.002	0.009	0.041	0.046	0.063	0.059	0.057	0.058	0.062
	16	0.061	0.032	0.017	0.001	0.007	0.038	0.050	0.066	0.062	0.058	0.064	0.069
	17	0.081	0.062	0.028	0.002	0.014	0.124	0.137	0.157	0.073	0.062	0.090	0.091
	18	0.098	0.099	0.064	0.011	0.033	0.229	0.320	0.825	0.125	0.092	0.095	0.095
	19	0.095	0.089	0.082	0.081	0.080	0.267	0.358	0.933	0.368	0.103	0.088	0.091
	20	0.089	0.082	0.081	0.077	0.082	0.262	0.446	1.034	0.497	0.101	0.085	0.089
	21	0.088	0.083	0.077	0.071	0.073	0.176	0.276	0.989	0.292	0.091	0.085	0.088
	22	0.090	0.082	0.081	0.072	0.070	0.082	0.088	0.720	0.143	0.088	0.088	0.090
	23	0.090	0.086	0.069	0.073	0.069	0.076	0.080	0.700	0.136	0.091	0.088	0.090
	24	0.091	0.087	0.067	0.071	0.072	0.074	0.074	0.088	0.093	0.090	0.086	0.091

Green – highest value export – Red – lowest value export

NBT – weekend export value 2025

	Total Export Rates - Weekends											
	2025 Base Rates (no adders)											
Hour of Day	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
1	0.089	0.081	0.056	0.068	0.069	0.073	0.072	0.084	0.080	0.078	0.082	0.082
2	0.090	0.080	0.059	0.069	0.068	0.069	0.065	0.081	0.082	0.078	0.079	0.079
3	0.086	0.079	0.062	0.074	0.072	0.069	0.065	0.077	0.081	0.076	0.078	0.078
4	0.085	0.078	0.063	0.081	0.077	0.063	0.068	0.076	0.077	0.076	0.079	0.074
5	0.086	0.078	0.065	0.084	0.075	0.069	0.064	0.076	0.079	0.075	0.079	0.074
6	0.089	0.078	0.067	0.073	0.072	0.067	0.066	0.077	0.078	0.074	0.081	0.075
7	0.092	0.075	0.063	0.076	0.065	0.071	0.061	0.073	0.078	0.072	0.082	0.079
8	0.085	0.067	0.069	0.055	0.031	0.061	0.052	0.062	0.062	0.065	0.061	0.065
9	0.066	0.040	0.010	0.005	0.006	0.022	0.034	0.049	0.036	0.047	0.046	0.041
10	0.056	0.025	0.002	0.007	0.010	0.020	0.030	0.049	0.032	0.027	0.041	0.022
11	0.056	0.024	0.009	0.014	0.010	0.022	0.030	0.046	0.032	0.026	0.031	0.021
12	0.055	0.026	0.006	0.010	0.010	0.016	0.031	0.045	0.030	0.026	0.030	0.020
13	0.055	0.024	0.011	0.003	0.008	0.021	0.031	0.041	0.030	0.021	0.026	0.019
14	0.053	0.027	0.005	0.000	0.001	0.019	0.027	0.046	0.030	0.018	0.025	0.020
15	0.052	0.022	0.000	0.000	0.000	0.017	0.028	0.046	0.031	0.022	0.023	0.019
16	0.058	0.023	0.002	0.000	0.000	0.014	0.027	0.049	0.036	0.022	0.050	0.046
17	0.083	0.055	0.018	0.000	0.002	0.015	0.026	0.061	0.049	0.048	0.078	0.088
18	0.100	0.091	0.040	0.009	0.010	0.028	0.048	0.691	0.115	0.083	0.086	0.088
19	0.096	0.093	0.084	0.080	0.067	0.086	0.092	0.749	0.422	0.091	0.083	0.085
20	0.089	0.083	0.080	0.078	0.081	0.088	0.112	0.977	0.568	0.086	0.082	0.083
21	0.088	0.079	0.078	0.070	0.070	0.079	0.097	0.813	0.286	0.085	0.081	0.082
22	0.088	0.076	0.071	0.071	0.066	0.078	0.082	0.743	0.143	0.080	0.085	0.082
23	0.091	0.078	0.072	0.070	0.066	0.077	0.075	0.737	0.144	0.090	0.088	0.083
24	0.091	0.084	0.072	0.069	0.067	0.072	0.073	0.089	0.089	0.090	0.086	0.081

Green – highest value export – Red – lowest value export

NEM vs NBT

- ***<u>Value of solar only generation gets cut by >65% vs NEM2</u>***
- Example system 10kw PV, solar value under NEM2 $6444/yr, under NBT only $2240/yr
- However, with large enough storage, used properly, ***you can still save under NBT***
- ***NBT 10kw solar+30kwh battery - $4910/yr savings (assumes load 18,000kwh/yr)***
- Uses only 4% per year of the cycle life of the battery - 25 year use.

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E-ELECT new rate for NBT
Similar to EV2

	EV2	E-ELECT
Summer		
Peak	$0.62277	$0.61418
Part Peak	$0.51228	$0.45230
Off Peak	$0.31026	$0.39562
Winter		
Peak	$0.49566	$0.38266
Part Peak	$0.47896	$0.36057
Off Peak	$0.31027	$0.34671

Peak: 4PM – 9PM, All Days
Part-Peak: 3PM – 4PM & 9PM – 12AM, All Days
Off-Peak: 12AM – 3PM, All Days

Summer: June through September. Winter: October through May
Bills refer to this rate as EV2A. EV not required for EV2, only solar+storage

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Optimal savings strategy under NBT

- Winter rate months – October through June (9 months)

- Solar energy stores power in batteries during the day, battery/solar runs loads ALL other times. Minimal grid use. Once battery is filled, excess solar not used by loads is exported to grid.

- Summer rate months – July through September (3 months)

- Solar energy stores power in batteries during the day, battery/solar runs loads ALL other times. Minimal grid use. Once battery is filled, excess solar not used by loads is exported to grid. Battery typically fills by noon. June-Sept, export battery to grid during max value hours 6-11pm

- Optimal battery size 3X the PV size, ex 10kw PV, 30kwh battery, but as battery prices are decreasing, more is better.

These can all be set for automatic operation, plus allow reserves, with some inverters (Sol-ark)

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Example Residential Solar+Storage Savings - PG&E New E-ELECT NBT rate

PV size kw	Storage Multiplier	Storage size kwh	Storage savings per kwh	Solar+Storage Savings	Raw Cost	Final Cost	Simple Payback Years	Payback with EV	10 year Total Income	Annual Cost-Savings
10.00	0	0.00	$0	$2,240	$35,000	$24,500	10.9	5.5	$1,037	$2,220
10.00	0.5	5.00	$102	$2,750	$38,000	$26,600	9.7	5.4	$4,751	$1,710
10.00	1	10.00	$108	$3,320	$41,000	$28,700	8.6	5.2	$9,149	$1,140
10.00	2	20.00	$98	$4,200	$47,000	$32,900	7.8	5.1	$14,982	$260
10.00	3	30.00	$89	$4,910	$53,000	$37,100	7.6	5.2	$18,876	($450)
10.00	4	40.00	$82	$5,520	$59,000	$41,300	7.5	5.3	$21,630	($1,060)
PV Rate $/watt	$3.50			E-ELECT	Residential					
Storage rate $/kwh	$600.00		LCOE	$0.130						
Savings rate PV $/kw	$224.00		Lifetime	25	years					
SGIP rebate rate $/wh	$0.00		PV Degrade rate	0.50%	Percent/yr					
ITC	30%		Battery Degrade Rate	1%	Percent/yr					
PV Size	10.00	kw	Storage Block Size		10	kwh	100%	percentage bat capacity used		
Storage Only	0	1 if calc for storage only								
Ave Load Rate	$0.290		$4,460	Load Cost						
Gen rate	1538	kwh/kw								
Solar percent of load	100%									
Annual gen	15,380	kwh								
Annual Load	15,380	kwh								
Average Daily Use	42.14	kwh								

Lifetime is used only for Levelized Cost of Energy (LCOE) calculation. PV lifetime is essentially infinite, 90% of power available after 25 years

Optimal savings strategy under NEM2

- Residential – EV2 rate plan – lowest off-peak rate
- Arbitrage – all year
- Save a portion of the solar power during the day (off-peak), dump to grid during peak periods
- Value is the differential between off-peak and peak $0.29/kwh summer, $0.18kwh winter
- Example, 10kwh used in arbitrage daily yields $367 savings summer, $449 winter total = $815/year,
- The more of the battery you use, the more you save.
- Keep portion for emergencies, switch off during fire/storm periods.

ELRP vs Arbitrage under NEM

- ELRP typically pays $2/kwh during summer months (defined as May-Oct). Events no less than 20 hours per year, no more than 60 hours/year (Tesla). Events are no more than 2 hours each. For a 10kwh discharge, 10 events (min) = $200. max 30 events = $600
- Arbitrage – June-Sept delta $0.29/kwh * 123 days*10kwh=$367, May plus Oct $0.18/kwh *62 days *10kwh=$111. Total=$478. If arbitrage all year round total=$815/yr
- Less cycling with ELRP, but less guaranteed value than arbitrage.
- ELRP more value under NBT.
- In either case, amount discharged is a tradeoff vs backup capacity available.

DSGS vs Arbitrage under NEM

- DSGS pays a fixed capacity value of $62.55/kw for the summer months – max is $350 - 5kw over 2 hours or 10kwh
- Arbitrage – June-Sept delta $0.29/kwh * 123 days*10kwh=$367, May plus Oct $0.18/kwh *62 days *10kwh=$111. Total=$478. If arbitrage all year round total=$815/yr
- Less cycling with DSGS, but less guaranteed value than arbitrage.
- DSGS more value under NBT.
- In either case, amount discharged is a tradeoff vs backup capacity available.
- No baseline requirement for new systems

Vehicle to Home (V2H)

- Current offerings
  - 2kw from 12V auxiliary system fed by traction battery in EV/hybrids
  - All EVs/hybrids have this capability
  - EV must remain on to maintain power
  - Sol-Ark Generator input supports use
  - Option on Custom Power Solar systems
  - Emergency use to backfill home & battery

Vehicle to Grid/Home/Load (V2G,V2H,V2L)

- Announced Chargers
  - Quaser 2 – 11.5kw
  - Delta – 10kw
  - Highbury – 7/11kw DC to AC
  - Fermata – 15kw DC to 480V AC
  - Dcbel Ara – 15kw DC to AC
  - Enphase Emporia – 11.5kw DC to AC
  - GM Energy
- Vehicles V2G/V2H
  - Leaf ZE1
  - GM Silverado EV, Denali, Blazer, Equinox, Lyriq
  - F-150
  - VW ID models
- Vehicles V2L
  - Mitsubishi Outlander PHEV
  - Hyundai Ioniq 5
  - Kia EV 5,6, Niro
  - BYD Atto 3
  - BYD HAN EV
  - MG ZS EV (2022)
  - Genesis GV60
- Many EV mfg now making with EVs bidirectional charging option or AC power output options

Vehicle to Home (V2H) example

- Potential example use case (EV2 rate):
  - Energy stored from solar during the day during off-peak (12am-3pm) into charging EV
  - Energy discharged to home and grid during part-peak or peak (4-9pm)
  - EV2 cost differential peak minus off-peak summer - $0.31/kwh, winter $0.19/kwh
  - Daily charge/discharge of 25% of battery capacity (60kwh *25%= 15kwh)
  - 15kwh * $0.31/kwh * 4mo * 30days = $558 for summer
  - 15kwh * $0.19/kwh * 8mo * 30days = $684 for winter
  - Total value - $1242/yr
  - Discharge rate – 15kwh/5hr=3kw
  - GHG savings – 48kg/kwh or 48 * 15 = 720kg/year
  - EV GHG savings – 8.5kg/gal of gas – average driving of 11,315 mi/yr 30mpg comparison car = 377gal gas saved, 3206kg of GHG saved/yr

EV value

- https://ev.pge.com/compare_vehicles
- http://custompowersolar.com/ev_vs_ICE_GHG.xlsx

EV value vs ICE

Car	Cost after incentives	Lifetime cost	Lifetime cost/mi	Fuel cost	mi/kwh	mi/gal	GHG mTons	GHG Mt/yr
Chevy Bolt	$27,200	$36,754.25	$0.25	$6,428.57	3.5		7.63	0.575449
Toyota Camry	$26,000	$59,464.93	$0.40	$24,771.43		35	36.77	2.773985
Tesla 3 standard	$47,000	$56,554.25	$0.38	$6,428.57	3.5		7.63	0.575449
Hyundai Kona	$33,550	$43,104.25	$0.29	$6,428.57	3.5		7.63	0.575449
Toyota Prius Prime	$25,075	$50,126.99	$0.33	$16,358.49		53	24.28	1.831877
Best		$36,754.25					7.63	
Worst		$59,464.93					36.77	
Difference		$22,710.69					29.15	
% improvement							79%	
Lifetime	150,000	miles						
Average use	31	mi/day						
	11,315	mi/yr						
Years lifetime	13							
Cost of electricity	$0.15	$/kwh						
Cost of gas	$6	$/gal						
GHG gas	0.0085806	mT/gal						
GHG electric off-peak	0.000178	mT/kwh						

GHG assumes using California grid off-peak – if solar powered GHG emissions may be 0. Does not include license fees. Includes average maintenance costs including tires.

Low Upfront Cost Financing Resources

- Property Assessed Clean Energy (PACE)
  - HomeRun Financing
  - Ygrene
  - Renew Financial PACE funding –
- CleanFund
- For Non-Profits – Collective Sun
- Green Bridge Energy
- GoGreenFinancing.com – useful tools to assess many energy improvement projects with financing resources

On Bill Financing

- PGE now offers OBF loans for business customers or a federal, state, county or local government agency
- Now includes energy storage! Storage must be on SGIP qualified equipment list
- 0% fees 0% interest loans

	OBF	OBF with Incentives[4]	Tier 1A
Interest	**0%**	**0%**	**0%**
Minimum Loan Amount	**$5,000**	**$5,000**	**$5,000**
Maximum Loan Amount	**$250,000** (**$4,000,000** per premises by exception[6])	**$250,000**	**$100,000**
Maximum Loan Term, not to exceed the Expected Useful Life (EUL) of the measures	**120 months**	**120 months**	**72 months**

Customers may take multiple loans to support their projects. The maximum loan perpremises is $4,000,000.

https://www.pge.com/assets/pge/docs/save-energy-and-money/energy-savings-programs/handbook_obf.pdf

Custom Power Solar

Cost Modeling Tools

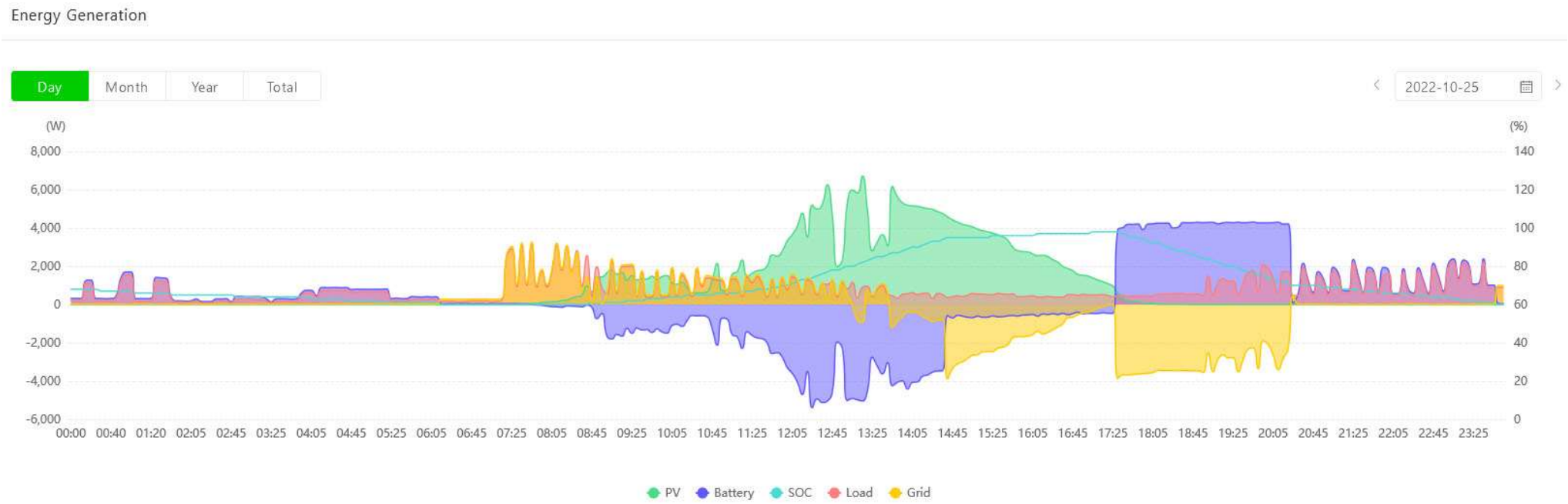
- Why do cost modeling?
- Determine cost savings using customer load profile and projected solar size
- Compare rates
  - Energy Toolbase
  - SAM (NREL)
- Developer runs analysis for you
  - Custom Power Solar

Simple approximation model – good for PG&E residential and commercial:
http://www.custompowersolar.com/savings_simple_models.xlsx

Cost Modeling Tool Tips

- Get the load profile
  - UtilityAPI – helps with format you need
  - PG&E Green Button
- Calculate solar size
- Best size - at least 100% of the annual energy usage in kwh of customer
- Quick estimate – Annual Usage(kwh)/1500 = PV size in kw
- Make sure size fits available space
  - roof
  - ground
  - carport

Residential Solar+Storage+EV – Arbitrage Daily Cycle



Cost savings through arbitrage – store solar power from beginning of solar at 7:20 to 2:45pm, discharge during peak rate period 5:30pm-8:30pm, and additionally power loads part-peak 9pm-midnight. 60% capacity held in reserve, max charge to 95% capacity to maximize cell lifetime. Note excess solar exported after 14:45. 40 kwh storage system

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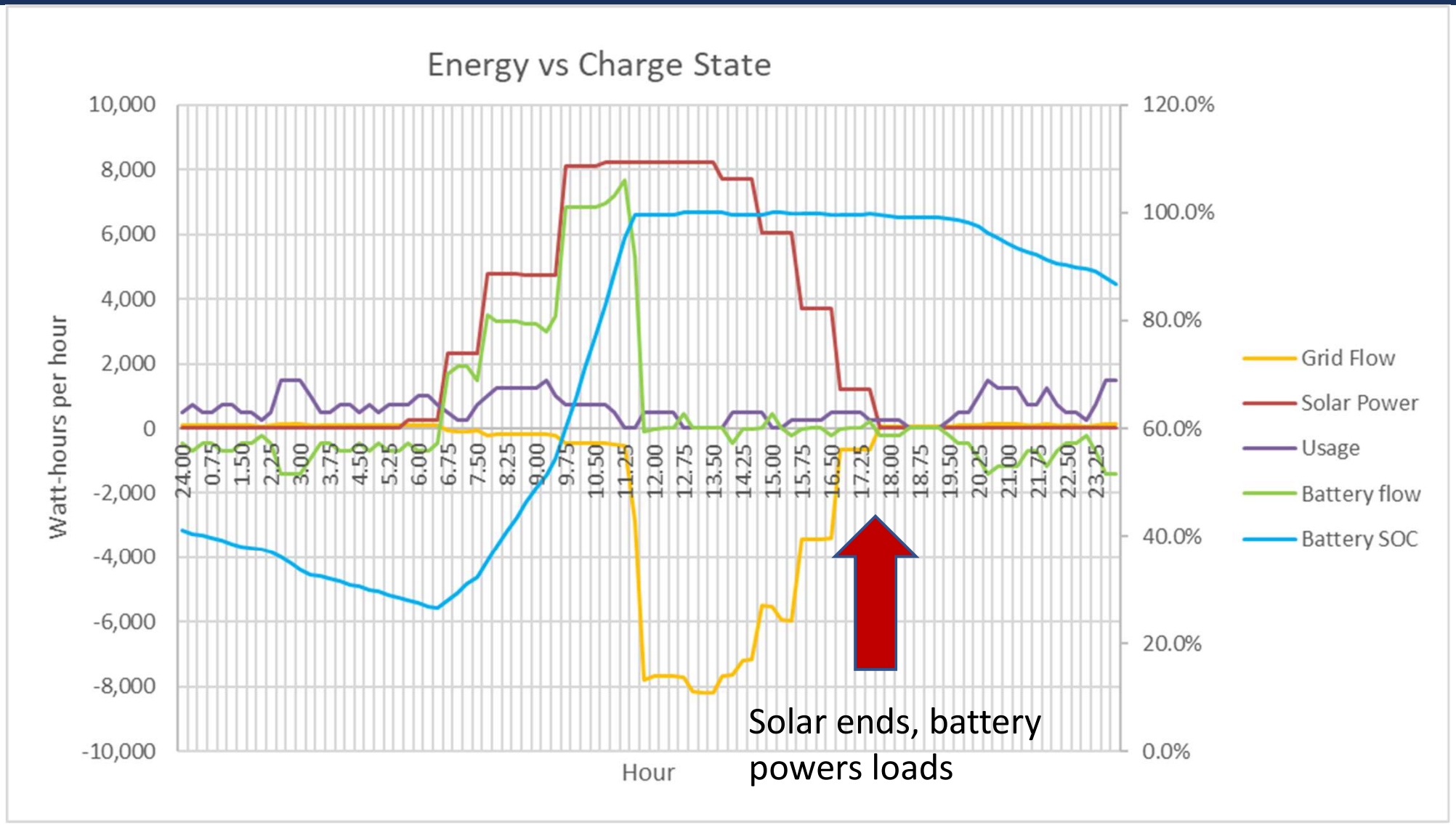
Resi Solar+Storage+EV Self Supply– Daily Cycle



3/24 – cost savings through self supply – store solar power in am, discharge during peak but only power loads

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Commercial Storage Systems

- Typical in USA 240V/480V 3 phase:
- Range of costs: $250-$1000/kwh – larger systems lower $/kwh $250/kwh for Mwh scale
- After ITC - $200- $500/kwh

B-1ST STORAGE RATE 2025

B-1ST		peak-offpeak
Summer		
Peak	$0.52863	
Part Peak	$0.38733	
Off Peak	$0.34000	$0.18863
Winter		
Peak	$0.43068	
Part Peak	$0.40118	
Off Peak	$0.31213	$0.11855
Super offpeak	$0.29571	
Demand charge	$8.50	

Summer: Peak 4-9pm
Part Peak 2-4pm and 9-11pm
Off Peak All other hours
Winter: Peak 4-9pm
Part Peak 2-4pm and 9-11pm
Super Off Peak 9am-2pm March, April, May only
Off Peak All other hours
Demand Charges: only 2pm to 11pm

Summer: June through September. Winter: October through May

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Battery Size vs Savings Solar+Storage

PV size kw	Storage Multiplier	Storage size kwh	Storage savings per kwh	Solar+Storage Savings	Raw Cost	Final Cost	Simple Payback Years	10 year Total Income	Annual Cost-Savings
100.00	0	0.00	$0	$32,000	$250,000	$175,000	5.5	$189,814	$14,140
100.00	0.5	50.00	$105	$37,250	$267,500	$187,250	5.0	$237,416	$8,890
100.00	1	100.00	$119	$43,900	$285,000	$199,500	4.5	$300,979	$2,240
100.00	2	200.00	$108	$53,600	$320,000	$224,000	4.2	$387,063	($7,460)
100.00	4	400.00	$74	$61,600	$390,000	$273,000	4.4	$429,266	($15,460)
PV Rate $/watt	$2.50		Rate	B-1ST	Up to 75kw demand				
Storage rate $/kwh	$350.00		LCOE	$0.086					
Savings rate PV $/kw	$320.00		Lifetime	25	years				
SGIP rebate rate $/wh	$0.00		PV Degrade rate	0.50%	Percent/yr				
ITC	30%		Battery Degrade Rate	1%	Percent/yr				
PV Size	100.00	kw	Storage Block Size		100	kwh	100%	percentage bat capacity used	
Storage Only	0	1 if calc for storage only							
Ave Load Rate	$0.300		$46,140	Load Cost					
Gen rate	1538	kwh/kw							
Solar percent of load	100%								
Annual gen	153,800	kwh							
Annual Load	153,800	kwh							
Average Daily Use	421.37	kwh							

Lifetime is used only for Levelized Cost of Energy (LCOE) calculation. PV lifetime is essentially infinite, 90% of power available after 25 years

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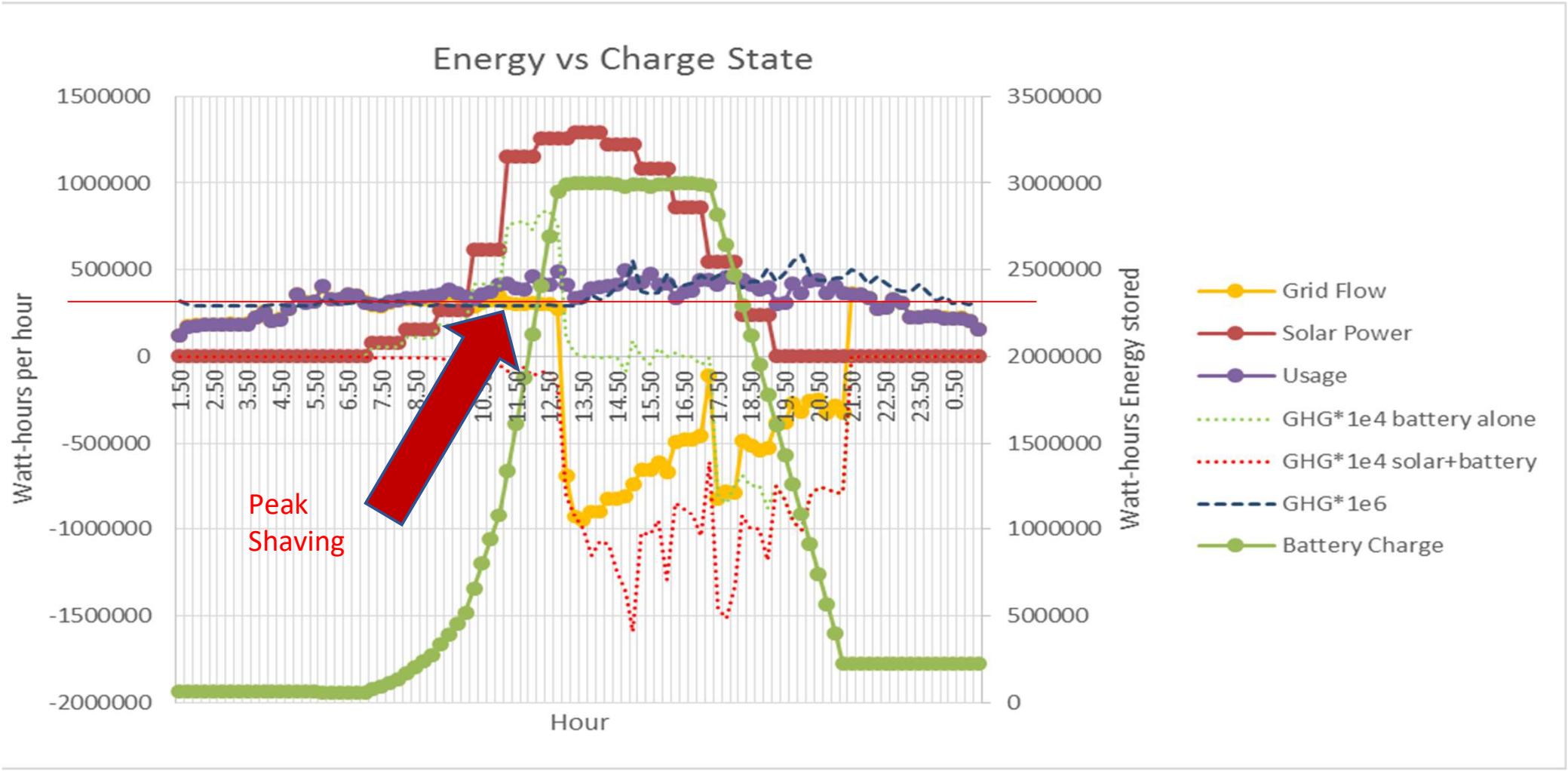
Commercial Solar+Storage – Arbitrage & Demand Reduction Daily Cycle



6/21 – cost savings through demand response – peak shaving (red line) and arbitrage – store solar power in am, discharge during peak

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Best Rates for Solar+Storage- Commercial

- PG&E
  - B-1ST
  - B-19R if solar only
  - B-19S if solar+storage or storage addon
  - B-20R(or S) – very large systems over 1MW demand

Conclusions

- Be conservative with storage cost savings projections – nothing worse than customers getting less than they planned on
- Design at least a 20% buffer in the size of the battery system
  - Improves lifetime
  - Reduces impact of day-to-day variations in use

Thank You!

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Custom Power Solar


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THANK YOU

Together, Building
a Better California