



**MICROGRID
KNOWLEDGE**

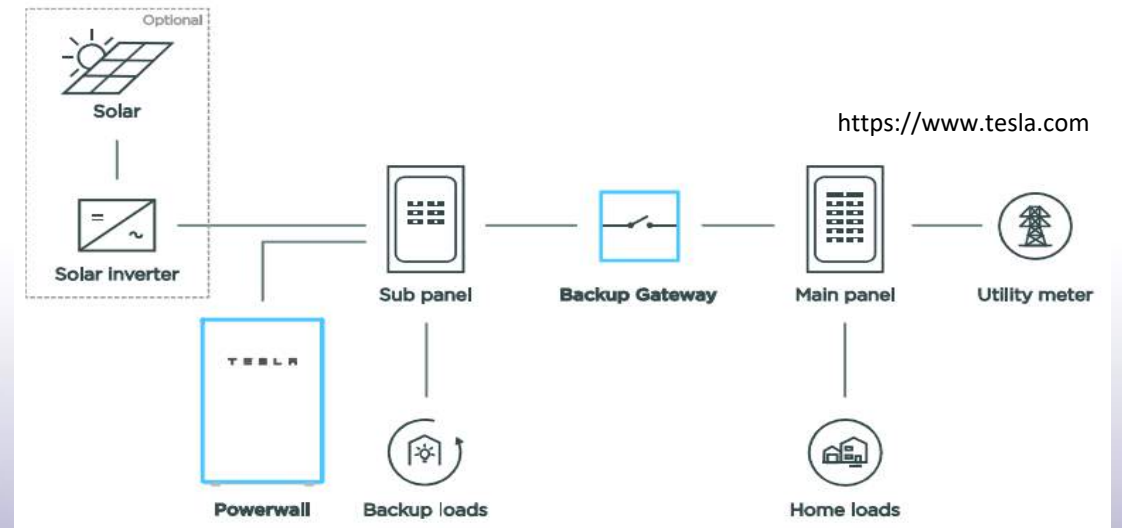
CONFERENCE SERIES

Microgrid 2019
CONFERENCE

Residential Microgrid

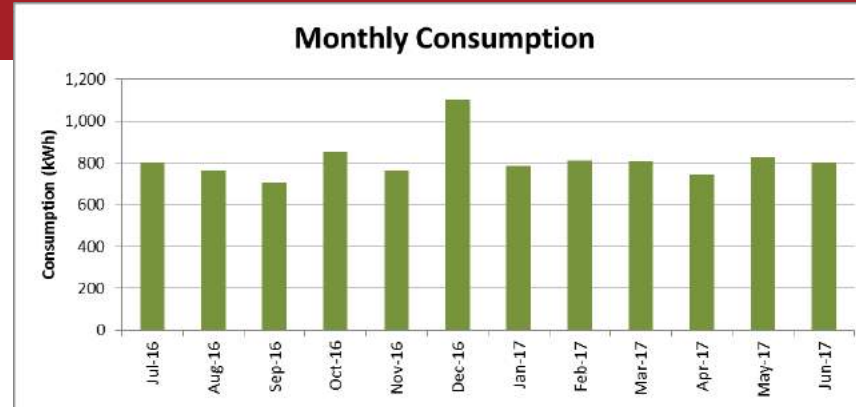
A Private Project

John Westerman



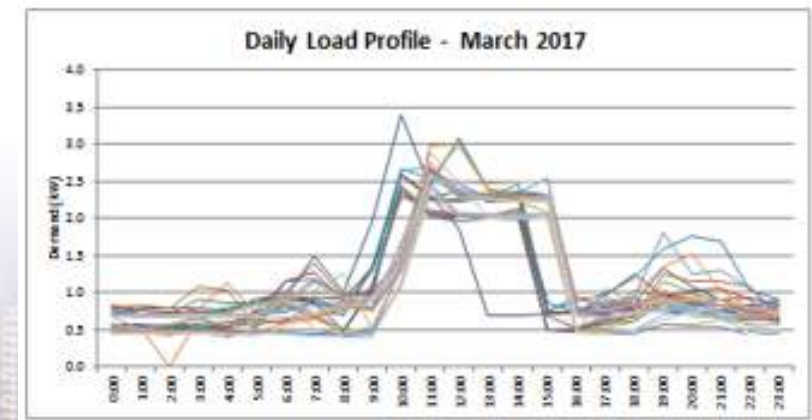
Site Overview

- Residence: San Diego, CA
- Built in 1989
- 2,202 ft²
- Four bedrooms
- Two Occupants
- Swimming Pool
- No Air Conditioning
- Tile Roof
- 100 Amp Electric Service
- Typical Electric Bill = \$260/month



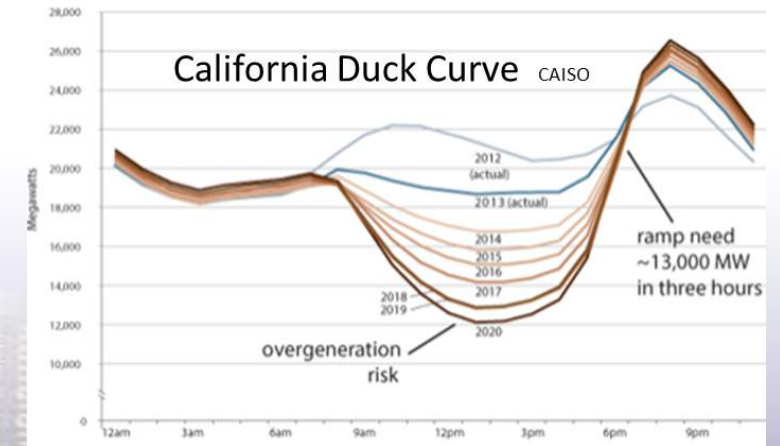
Month	Consumption (kWh)	Teir 1 (\$)	Teir 2 (\$)	Total (\$)
Jul-16	801	\$77.22	\$179.60	\$256.82
Aug-16	763	\$77.22	\$164.40	\$241.62
Sep-16	707	\$77.22	\$142.00	\$219.22
Oct-16	850	\$77.22	\$199.20	\$276.42
Nov-16	766	\$77.22	\$165.60	\$242.82
Dec-16	1,104	\$77.22	\$300.80	\$378.02
Jan-17	787	\$77.22	\$174.00	\$251.22
Feb-17	810	\$77.22	\$183.20	\$260.42
Mar-17	804	\$77.22	\$180.80	\$258.02
Apr-17	744	\$77.22	\$156.80	\$234.02
May-17	828	\$77.22	\$190.40	\$267.62
Jun-17	800	\$77.22	\$179.20	\$256.42
Total	9,764			\$3,142.64

Avg \$/kWh \$0.322



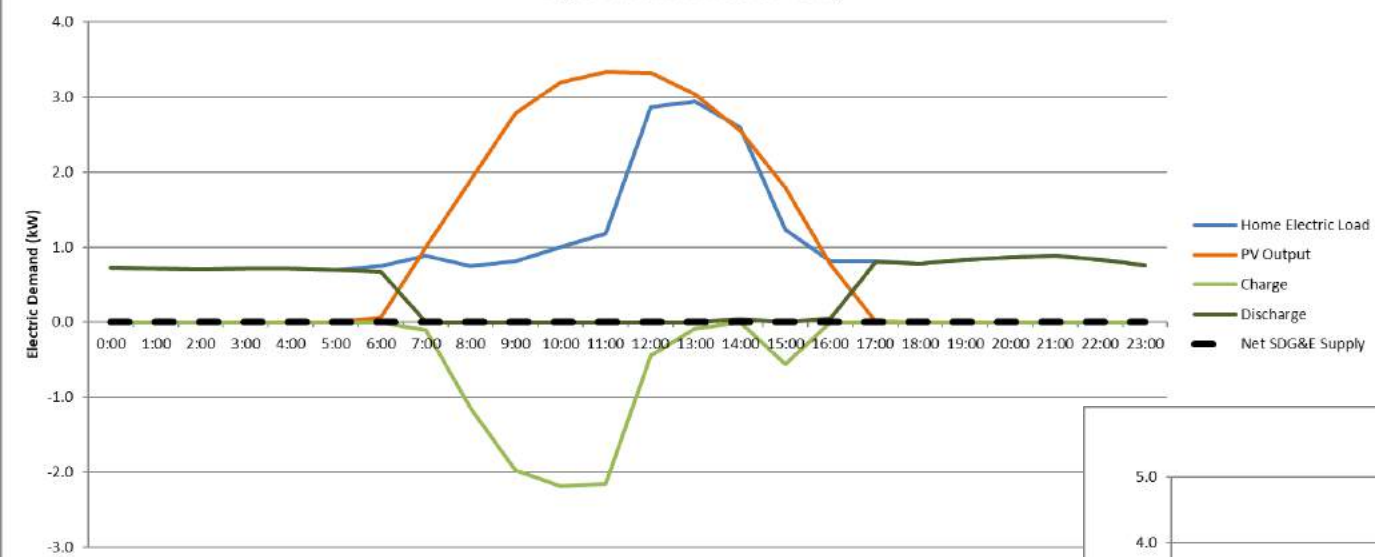
Project Scope

- Re-roof Entire Roof with New Tiles
- New Solar PV
- Replace Pool Thermal Heating Panels
- New Battery Energy Storage System
- Keep All Electric On-site (no export)
- Backup Power for Critical Loads:
 1. Cable Box, Router & VoIP Phone
 2. TV, Radio & Speakers
 3. Refrigerator/Freezer (qty=2)
 4. Garage Door Opener
- Electric Sub-Meter: Same Point as SDG&E Meter



Modeled Operation

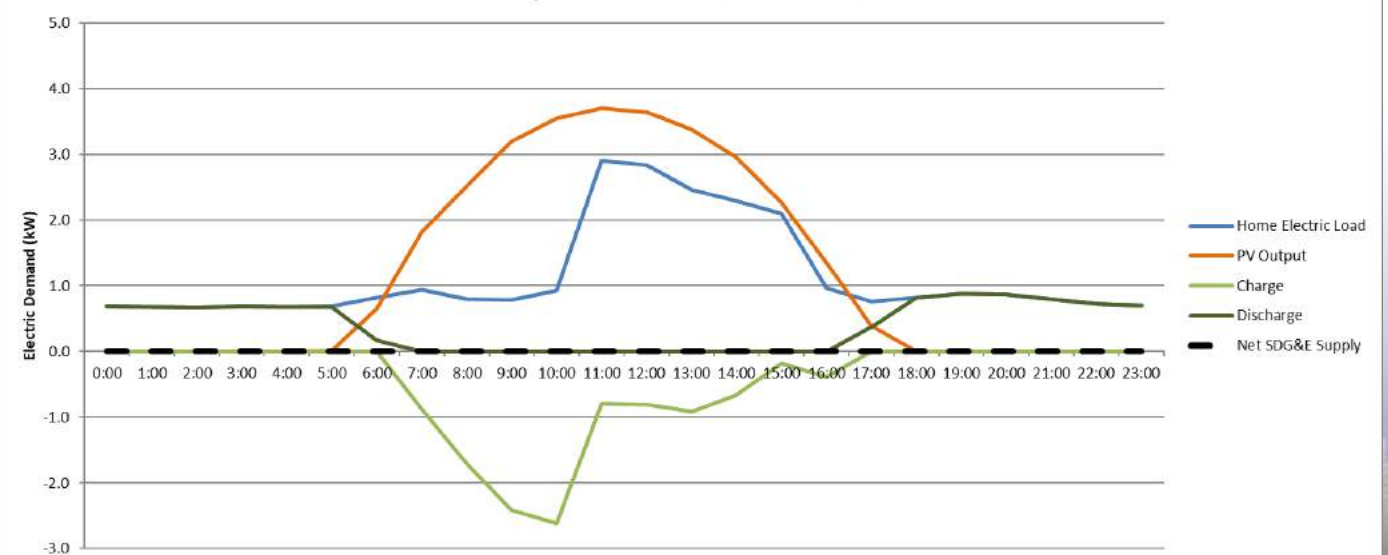
Operational Model - July



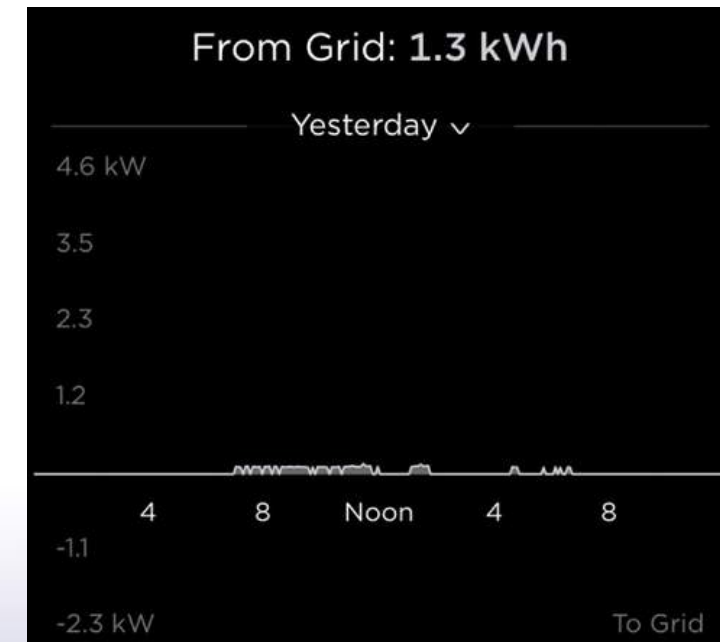
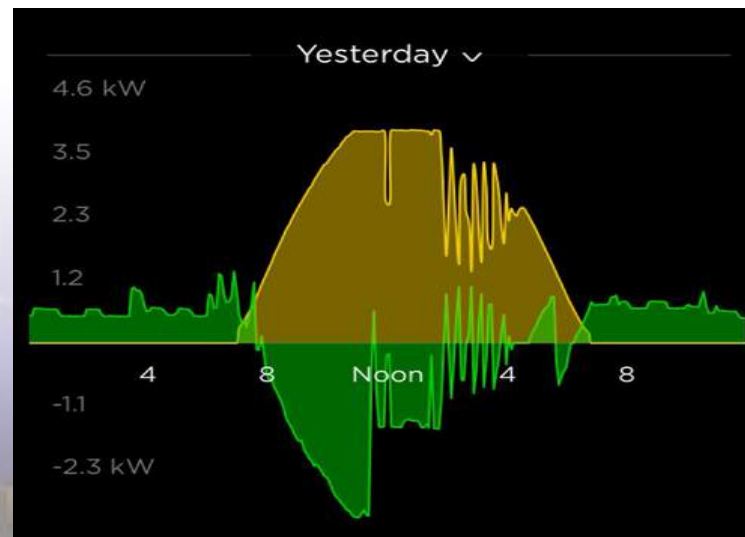
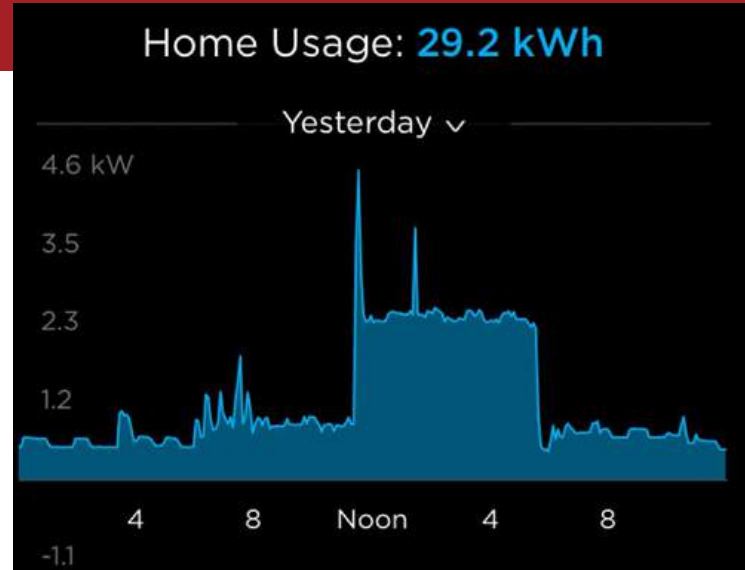
- Accessed interval data from SDG&E online account
- Modeled PV generation with PVWatts
- Developed model to size energy storage based on PV sizing against load profile

- PV and Storage sized for no export to the grid
- Storage Charges from excess PV generation

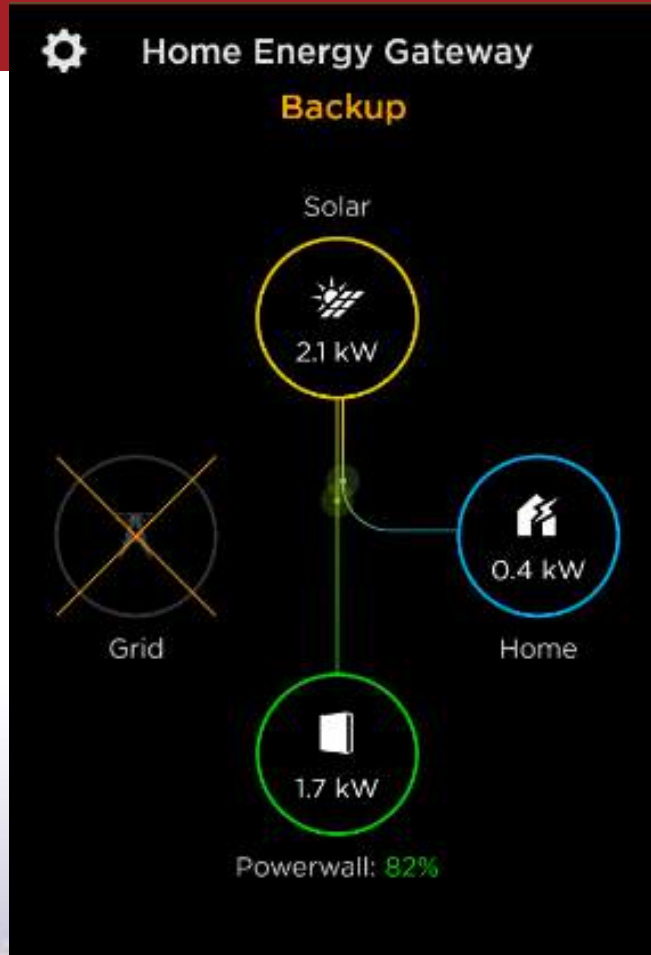
Operational Model - October



Operation – Self Consumption Mode



Operation – Island Mode



BACKUP HISTORY

EVENTS: 12 events

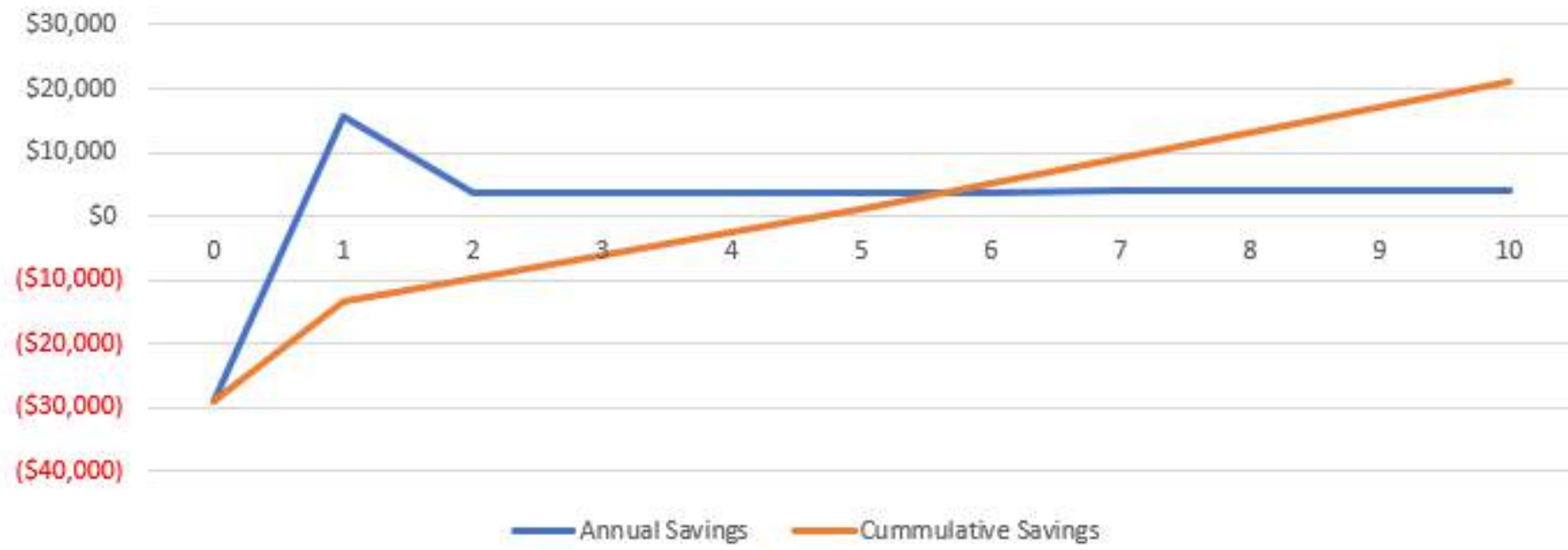
BACKUP POWER: 15 total backup hours

DATE	BACKUP POWER
December 13th	9 hours, 5 minutes
October 15th	2 hours, 0 minutes
September 13th	1 hour, 14 minutes
September 12th	26 minutes
August 19th	19 minutes

- Average Load on Critical Circuits ~ 0.5 kW
- Critical Circuits:
 - Kitchen
 - Family Room
 - Master Bedroom
 - Garage
- PV isolated and able to operate when the grid is down
- PV meets load and excess generation used to charge storage
- Energy storage able to meet critical loads throughout the night

Economics

Project Savings Projection



Utility Electric Costs

Annual Bill Before	\$3,100
Annual Bill After	\$360
Annual Savings	\$2,740

PV & Battery Cost

Installed PV System	\$15,900
Installed Battery	\$10,000
Total Cost	\$28,900

Incentives

ITC	\$8,670
SGIP	\$3,480
Total Incentives	\$12,150

Net Cost \$13,750

Simple Payback 5.0
IRR 15%

- Year 0 Costs = \$28,900
- Year 1 Savings = \$15,610 (ITC, SGIP, and electric savings)
- Assumes a 2% escalation for utility electric costs